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Servicing the Moulder

In a report "Servicing the Moulder. A Review of Productivity in the Grey-iron Foundry Industry" published by the Anglo-American Council on Productivity of 21, Tothill Street, London, S.W.1, an account is given of the progress this section of the foundry industry has maintained in recent years. No exaggerated claims are made for the beneficial influence of the findings of the team visiting America on the industry's improved and improving productivity. The basic figure which can be used for this purpose with some degree of certainty is the annual weight of the production of castings turned out by the labour force employed. This, in recent years, has been quite healthy and merits the congratulations of the whole country.

The author of the Report has wisely taken each major process in the production of grey-iron castings and has instanced many uses where real progress has been achieved. The average foundry executive in reading over these stories of achievement is bound to be reminded where he, too, could make changes beneficial to his output. The report emphasises that it is the jobbing foundries where the major progress can be made. This is a really difficult proposition because at any cost, elasticity in production methods must be maintained. When one modernizes a shop there are two main phases —the *mise en marche* and the *mise au point*. The first expression covers the planning and starting up of the new plant, whilst the second—which never ends—is the adjustment of manufacturing processes to attain, at the minimum, meticulous control, and finally perfection.

The commendable results outlined in the Report are to our mind as much the consequence of the issue of the "Garrett Report" as to any other factor. Whilst there were no threats in that report, there was a general feeling abroad that something must be done along the lines suggested or an unpleasant stigma would be placed upon those who remained too complacent. The title of this new Report, "Servicing the Moulder," is one which has been the subject of discussion in this column and in practice can be interpreted as a series of actions ranging from the provision of machinery for the supply of adequate quantities of prepared sand to the adjustment of a bench to a better working height. The £15 million spent by the industry since 1945 has not been wasted, even though much has been expended on amenities. We cannot imagine the Report will have much interest for people outside the foundry industry, but, for those whose day-to-day existence is taken-up in the manufacture of castings, it is a stimulating document. Moreover, it is not only of interest to the ironfounder but to every section of the foundry industry. Despite this, for the future we think the provision of such information as is contained in this Report could be equally well gathered and disseminated by the existing trade organizations.

I.B.F. Buxton Conference Fund

A final list of subscriptions to the special fund which has been raised by foundrymen and friends in the Sheffield area in connection with the recently-held Annual Conference of the Institute of British Foundrymen at Buxton is reproduced below.

	£	s.	d.
Samuel Osborn & Company Limited	103	19	1
Pickford Holland & Company Limited	10	10	0
Parkgate Iron & Steel Company	10	0	0
Rose, Down & Thompson	5	5	0
W. G. Pallett (Laycock Engineering Company)	5	5	0
Darwins Limited	26	5	0
Staveley Iron & Chemical Company Limited	50	0	0
Firth Vickers Stainless Steels Limited	25	0	0
Davy & United Engineering Company Limited	28	0	0
C. & J. Hampton Limited	25	0	0
General Refractories Limited	50	0	0
T. W. Ward Limited	100	0	0
Stanton Ironworks Company Limited	50	0	0
Wm. Jessop & Sons Limited	50	0	0
Hinckleys Limited	26	5	0
Thos. Firth & John Brown Limited	52	10	0
Daniel Doncaster	6	6	0
J. & J. Dyson Limited	10	0	0
The Clay Cross Company	75	0	0
F. Parramore & Sons (1924) Limited	10	0	0
Markham & Company Limited	25	0	0
H. Johnson, Foster Limited	8	13	7
Bryan Donkin Limited	26	5	0
Qualter, Hall & Company	4	0	0
Wm. Oxley & Company Limited	4	4	0
Alloy Steel & Iron Company	2	2	0
Hadfields Limited	157	10	0
British Electro Metallurgical Company Limited	10	10	0
Wm. Wild & Sons Limited	2	12	6
Wm. Lee & Sons	20	0	0
Henry Hardwick & Sons Limited	5	5	0
David Brown & Sons (Huddersfield) Limited	25	0	0
Edward Eastwood Limited, Chesterfield	2	2	0
Robert Hyde & Son Limited (Chesterfield and Stoke-on-Trent)	10	10	0
Wm. Cook & Sons Limited (Sheffield)	5	5	0
George Oxley & Son Limited	50	0	0
United Steel Company Limited	50	0	0
Brass Founders (Sheffield) Limited	5	5	0
Edgar Allen & Company Limited	200	0	0
The Brightside Foundry & Engineering Company Limited	100	0	0
Renishaw Iron Company Limited	25	0	0
John Fowler & Company (Leeds) Limited (Sprotborough)	26	5	0
English Steel Corporation Limited	250	0	0
Anonymous Donor	0	10	0
Leigh & Sillavan Limited	15	0	0
Yates, Haywood & Company Limited	5	5	0
Arnold Booth & Sons Limited	1	15	0
Newton Chambers & Company Limited	150	0	0
M. G. Pearson	0	10	0
James Durrans & Sons Limited	10	10	0
Sheepbridge Engineering Limited	75	0	0
Foundry Trades' Equipment & Supplies Association	138	14	0
	£2,131	18	2

Through Brigadier Levesley, the conference fund treasurer, we are asked to express the thanks of the Institute to all who have given so generously and thus contributed so largely to the success of the various functions.

London branch Again Visits France

Last year, a party from the London branch of the Institute of British Foundrymen spent a very profitable long week-end visiting foundries in the French Ardennes. This year the function is to be repeated, but Paris is the venue. To-day, two parties each of about 20 members leave for the French capital, one by train/sea and the other by air. They will stay in the city and inspect a number of foundries in the area as well as the newly-opened headquarters of the Association *Technique de Fonderie*. The whole programme, which lasts until July 1, has been formulated with the kind assistance of the French foundry organization, and it is confidently expected that the interchange of experiences will be of mutual value and lasting worth on both sides.

Extensions to the Tortoise Foundry

A substantial scheme of reconstruction and expansion is going on at the old-established "Tortoise" foundry at Halstead, in Essex. When completed the foundry will have increased in size by nearly 50 per cent. and will provide much better working conditions for employees. One of the main objectives of this reconstruction is to give moulders more room and to expand gradually by training more moulders.

The first move in this plan of reconstruction was the erection of a large new oven and blacksmith's shop, measuring some 165 by 36 ft., high and airy, with the latest Colt system of ventilation. Nearby has been provided increased storage space for the world-renowned "tortoise" stoves which are among the firm's products.

New Coreshop and Moulding Shop

For the foundry proper, expansion has here been made possible by the acquisition of most of the site of an old gasworks. A new coreshop, measuring 64 by 35 ft., has been built and equipped with three new core-ovens, by Modern Furnaces & Stoves, Limited. This building also has Colt ventilation.

A large new moulding shop is in course of erection and will consist of two bays, one, approximately 85 by 37 ft., will be utilized for medium-size castings and will have two 2-ton overhead electric cranes. The other, some 123 by 33 ft., will link up with the existing "big" foundry, which will thus be doubled in size and will contain two 6-ton overhead cranes capable of dealing with the biggest castings handled by the firm. This building will be fitted with Hill's ventilation, with two sets of electrically-operated shutters which can be opened according to the prevailing wind, or alternatively, in suitable weather, opened completely to the sky. This part of the plan will necessitate the removal of the old cupolas. Two new ones, in which the iron for the whole foundry will be melted, have been erected just outside the new foundry buildings and are fitted with dust arresters. They will be used on alternate days, and are charged by electric inclined bucket hoists.

Welfare

The remaining space in the new extension will be utilized for welfare buildings, with first-aid, showers, etc. Above will be the new offices of the new associate Companies; the Tortoise Foundry Company, Limited, and C. Portway & Sons, Limited.

It is hoped that the switch-over to the new cupolas and foundry will be possible during the works summer vacation, which commences on July 25.

A local firm, J. S. Norton, are the contractors, the steelwork is by Cocksedge, of Ipswich, and the new cupolas are by Ropers, of Keighley, Yorks. It will be appreciated that extending old premises without loss of output has brought considerable technical problems; and great credit is due to all concerned: the builders, steelworkers and the foundry staff, especially Mr. Russel Graham and Mr. Basil Argent.

THE FIRST EDITION of "Rolls-Royce News," a well-illustrated paper, was dated June 20. It is for employees only, and is to be issued each month.

LAST MONDAY, Sir Archibald Rowlands, C.B.E., re-opened the Guest Memorial Hall at Dowlais. This building was created by subscriptions from his work-people as a memorial to Sir Josiah John Guest who died in 1852. In recent times it has been requisitioned by the military, but now has been entirely reconstructed to provide one of the finest clubs of this type in the country.

Flow of Metal*

Report of Sub-committee T.S.35 of the Technical Council

Sub-committee T.S.35:
E. M. Currie (Chairman), F. Hudson, G. W. Nicholls, R. W. Ruddle, J. Hird, G. Lambert (secretary to the Sub-committee)

Sub-committee T.S.35 of the Institute was appointed in October, 1950, with the constitution given above and with the following terms of reference:—

"To study the flow of metal into moulds and record by colour cinematography or other suitable means."

This sub-committee was formed out of a prior sub-committee (T.S.29) appointed for the purpose of examining all known methods of recording the flow of metals and liquids into shapes representing moulds. Full consideration was given to Fry's method of using X-ray photography, Johnson and Baker's [2] investigation into the influence of the effects of gate design in steel casting, and also Swift, Jackson and Eastwood's [3] work with liquids in Lucite moulds. A film previously made by the Meehanite Research Institute on metal flow-patterns into open-top moulds [4], and Tedds' [5] method of using mercury in glass sided plaster of paris moulds, were also studied, along with others [6].

It was early realized that, within the limitations of present-day recording methods, and of matching-up experimental gating ideas with normal foundry practice, the use of fairly-high-speed photography with a ciné camera would provide the type of record best suited for instructional purposes, but that certain moments in the sequence of tests could be photographed statically in order that particular points might be raised for special discussion, without damage to the film record. It was also considered that as the film was to be made primarily as a basis for discussions by practical foundrymen on all aspects of ingate design, the effects of mould-shape, finish, sand condition, cleanliness, slag-entry prevention, and metal flow-patterns, these points could best be shown by using normal green-sand moulds, open at the top, emphasizing the fact that the final aim of good gating practice is the production of a clean, sound, dirt and slag-free casting by practical gating methods.

Objectives of Photography

It was, therefore, finally decided to record the flow-patterns of metal entry through different types of ingate, using colour film ciné photography at 64 frames a second, the limiting speed of the ciné apparatus available to the sub-committee at this period. Trial tests indicated that at this speed, and using in general normal areas and sizes of downgate, runner-bar and ingate, the record made was sufficiently accurate and prolonged, for good observation of the various effects produced. It is also fully realized that the film does not cover all aspects of good gating practice, nor of all the various types of ingates used in the foundry. This would be virtually impossible within the limits of normal ciné viewing, and is not attempted. Nor is there any attempt at recording gating that occurs in the vertical plane.

The main theme of this film is to show the pattern of flow, as the mould is filled from various standard types of ingates. The importance of this is the relationship of metal temperature-gradients within the mould proper, and to postulate therefrom the correct and properly arranged solidification rates which assist towards:—

(1) Progressive or directional solidification;
(2) minimization of casting strain, and
(3) prevention of warping, distortion and possibly cracking, after cooling.

The other aspects of good gating-practice are, of course, not ignored by the film record. These are:—

(4) To prevent the entry of dirt and slag, and
(5) to get all the metal into the mould at such a rate as to:—
(*a*) allow gases to escape.
(*b*) minimize internal shrinkage and porosity.
(*c*) maintain accurate shape and reduce misruns.
(*d*) obviate mould erosion.

Naturally the method of moulding used for the film necessitated certain factors normally considered by the foundry when placing and using various gating systems, to be ignored or accepted in compromise. For example, the velocity of the metal entering the various mould shapes is different and lower, to an unknown degree, than the velocity of metal entering the mould through the same size downgate, runner-bar and ingate area, but having a higher ferrostatic head pressure due to the mould basin resting on the top part, instead of on the mould joint as in the case of all the film shots. Secondly, the internal pressures generated in a closed mould system, are absent with open moulds. Thirdly, the mechanics of ciné photography dictated a fixed choice of downgate diameter and runner-bar, which naturally alters somewhat the speed and volume of metal passing through the various ingates in a standard unit of time.

Nevertheless, every attempt was made to conform to general foundry practice in choosing

* Presented to the Buxton conference of the Institute of British Foundrymen.

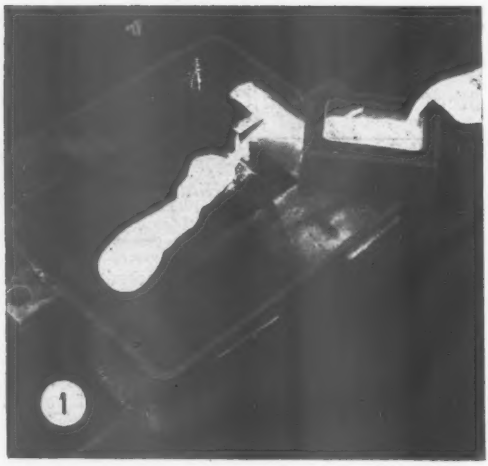


FIG. 1.—*Series III* (1)—*Parallel-sided Ingates.*

passage areas. It should be noted that an average time of four seconds elapsed between the moment of pouring into the basin and the covering of the bottom of the mould, and it was considered that this time would normally be employed with plain moulds of similar size (no cores or varying section thicknesses) in actual practice using high-strength cast irons. Here again, it is appreciated that with high-phosphorous high-silicon grey irons and other metals, the pouring rate in normal foundry practice must be adjusted to suit the cooling and fluidity characteristics of the metal.

Relation to Normal Practice

Obviously, in actual practice the size of the gates employed is governed by the type of casting being poured. Normally, a heavy, flat plate is poured quickly to avoid pulling down the top mould face. A mould with high surface areas including intricate cores needs fast pouring in order to avoid misruns, but the same mould might under certain conditions of venting, be poured somewhat more slowly to allow gases to escape readily. Top pouring-gates can be a little smaller than in bottom-poured moulds. Dry-sand gates can be smaller in area than when cut in green-sand, and above all, the average metal temperature and fluidity rating will affect gating-area considerations. The heat conductivity of the mould material will affect the length and shape of ingate, and thus affect pouring speed, as will also the possibility of mould and ingate erosion.

It will be readily understood, therefore, that whilst an arbitrary relationship of downgate diameter, runner-bar size, and ingate area was chosen for the experiments, it may well be argued that in view of all the various gating factors considered above, there is no known method of calculating precise gating area relationship to suit all mould conditions, and therefore a reasonable compromise, such as has been adopted in this particular instance, is a perfectly logical and eminently practical basis on which to begin the consideration of gating practice.

It is emphasized that the film deals only with elementary ingate forms and the logic behind the choice is perfectly clear in the record. The most complicated gating system is based entirely upon such simple forms and a skilled foundryman will readily appreciate that by his understanding of the basic idea, and his skill and ingenuity in adapting it to the complete assembly of a gating system which will include provision for dirt- and slag-trapping and skimming, and choking for control of speed of entry of metal, the successful manufacture of the casting is not a result of chance or luck but of applied thought and sound reasoning.

The sub-committee therefore feels that it is preferable to present this film as a practical contribution to the subject of gating and the pouring of metal, rather than to use it as the basis for theoretical discussions into such subjects as the hydrodynamics of fluid-flow velocity, frictional retardation, gravity and pressure effects, viscosity or effect of surface tensions. The mechanics of fluid-flow is as yet a science that will be slow to enter fully into the foundry industry, and if by reason of the film some castings are made better and defectives are reduced, then our industry will be well served.

FILM: "FLOW OF METAL INTO MOULDS"

Explanation

The opening sequence of the film shows a green-sand mould of a simple circular plate about 9 in. dia. by 2 in. deep having a simple direct entry ingate from a "flow-by" runner-bar, and was photographed at the normal ciné camera speed of 16 frames per sec. It will be noted that a considerable amount of metal turbulence is apparent. The green-sand mixture used consisted of:—1 pt. Bromsgrove red; 1 pt. Mansfield red; 2 pts. black sand; 1 per

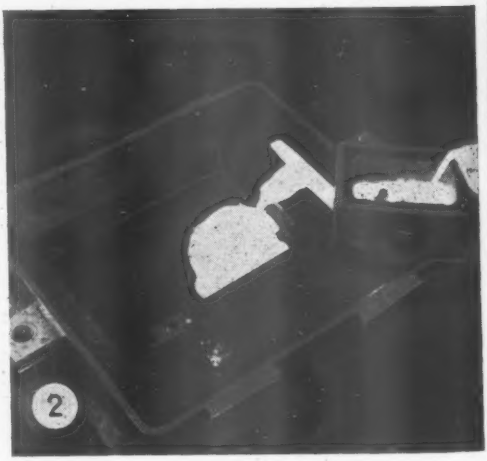


FIG. 2.—*Series III* (2)—*Wide End to Mould Cavity.*

cent. proprietary colloidal clay; 8 per cent. coal-dust; moisture 6 per cent. and had a permeability of 35 and a strength 9 lb. per sq. in. Hard ramming and insufficient venting were contributory causes of the turbulence noted.

In pouring the second mould, having same size and shape and the same ingate system (which experiment was to be used to demonstrate the effect of higher-speed photography), the bottom of the mould, made in the sand mixture quoted, was well vented with a needle wire. The reduction of metal disturbance was clearly apparent by visual observation, as was the pattern of the metal flow. These tests formed the basis of the adoption of the technique used for the remainder of the film, except that, from series III, the sand mixture was changed to:—Two parts red sand (Bromsgrove and Mansfield), four parts black sand, 8 per cent. coal dust, moisture 4½ per cent. average, giving permeability 38 and strength 8½ lb. per sq. in.

Very little or no metal turbulence was evident in succeeding shots from mould conditions from series III onwards, and all were taken at a camera speed of 64 frames per sec., to show clearly the metal pattern formed in the mould by the various types of ingates used. The pouring basin in all cases was made from an oil-sand mixture, well dried, with a dished bottom for easy and clean pouring, and a standard ⅜-in. dia. downgate was used in all cases.

SERIES II

The next three pictures show the metal flow-patterns from three simple-shaped ingates. In this series (No. II), in order to ensure that the metal flowed quietly into the mould without flooding the mould joint, the ingates and sides of the runner-bar were covered by core-sand strips. This was found to be unnecessary in subsequent shots. However, for this series the cover-core masks the three

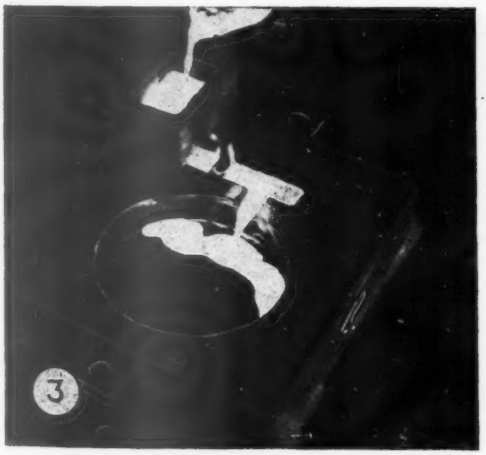


FIG. 3.—*Series IV* (2)—*Dam Skimmer Core placed across Runner-bar.*

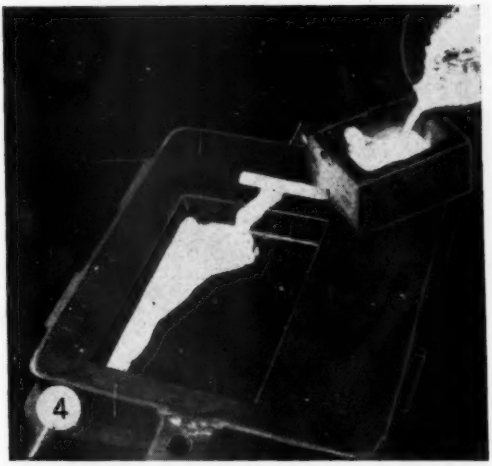


FIG. 4.—*Series V* (3)—*Tangential Forward Entry.*

simple ingate shapes, which were respectively:—(1) Parallel sided; (2) wide end to the mould cavity, and (3) nozzle end to the mould cavity.

It will be noted that in the case of (2), the wide and relatively shallow stream of metal entering the mould seems to create more disturbance of the metal in the mould than either the parallel-sided ingate, or the ingate with narrowed end to the mould cavity. The actual average area of the ingate between the runner-bar and the mould is the same in each case, and thus the rate of flow of the metal is the same, but the pattern formed in the square mould cavity varies with the frontal shape.

SERIES III

The next series of shots (No. III) is to show more clearly the effect of ingate shape on the metal flow-pattern using the same mould shape as in the previous series of three ingates. In this case, the ingates are uncovered and the flow of metal through the ingate sections can be seen more clearly. The ingate shapes are as follow:—

(1) Deep and narrow width (1 in. deep, ¼ in. wide) (Fig. 1).

(2) Wide and shallow depth. The ingate had been blackened with plumbago and some bubbling of the metal in the ingate can be seen (Fig. 2).

(3) Spoon gate—entry of some slag is shown.

(4) V-notch gate—reasonably quiet entry of metal.

(5) Venturi-shaped ingate; note that the frontal shape of this ingate does not control the flow-pattern—the narrowed central portion controls the flow of metal.

(6) Horn gate—normal pattern small end to mould cavity—note the high velocity of the metal.

(7) Horn gate reversed, wide end to mould—much quieter flow of metal. It is, of course, understood that this type of ingate is not normally applied to simple flat-plate type moulds, unless possibly the castings were being chilled on outside edges, but the

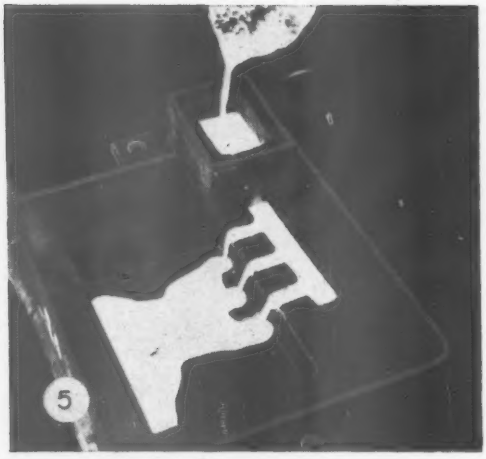


FIG. 5.—*Series V (5)—Multiple-ingate Entry.*

effect of ingate shape is clearly shown and can easily be related to the effect produced when used on gear, pulley, or similar types of moulds in which a horn gate may be utilized.

SERIES IV

Series No. IV was next designed to show the effect or influence of alteration to the runner-bar shape, using a simple circular-shaped plate mould.

(1) Simple straight ingate from a "flow-by" runner-bar. This is practically the same shot as in Series II (No. 1) and merely refreshes the memory on the metal pattern produced.

(2) In this case a dam-skimmer core is placed across the runner-bar to hold back any slag or dirt —no slag could be induced to flow into the bar from the basin owing to the care of the pourer in keeping the basin full of metal (Fig. 3). The ingate is the same size as the preceding shot.

(3) The use of a filter-core in its more natural position at the bottom of a downgate or at the bottom of a runner basin is well known. However, to show what happens when a filter core is inserted against an enlarged ingate (which could also serve as a side riser) the next shot was taken. The total area of filter-core holes controls the rate of metal flow. It will be noticed, however, that not every hole passes metal, but this deficiency could be caused in this instance by the lower velocity of the metal and reduced pressures caused by the lower ferrostatic pressure from a joint-high runner-basin.

(4) The final type of ingate used in this series comprises the well-known whirlgate. Here again, possibly due to reduced velocity of metal on entry to the bob, the whirl of the metal is not very apparent except at the beginning of the photograph, but it does show the efficacy of this type of gate in holding back some of the slag which may enter the runner system from the basin.

SERIES V

In Series V, of the present film, the main idea was to portray the effect on the metal flow-pattern produced in a square mould by altering the position of the ingate along the runner-bar.

(1) Normal square ingate at one end of a runner-bar, with the downgate at the other end.

(2) Same ingate in the middle of the runner-bar. In this case the first flush of metal goes down the centre of the mould, whereas in the preceding shot the slightly increased velocity of the metal at the end of the bar tends to throw the metal towards the side of the mould. In any case, such a runner system must inevitably allow any dirt or slag formed to enter the mould cavity, whereas in the second case

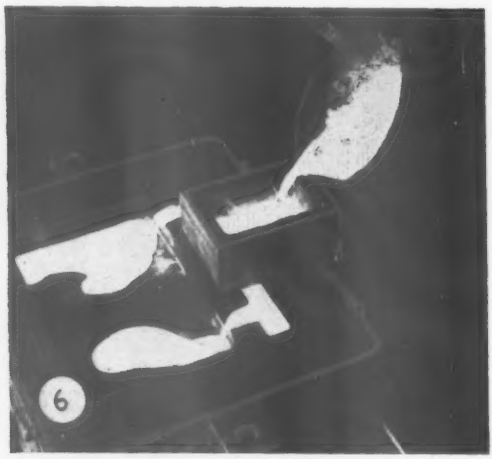


FIG. 6.—*Series V (6)—Two Downgates at End of Runner-bar, Downgate Central.*

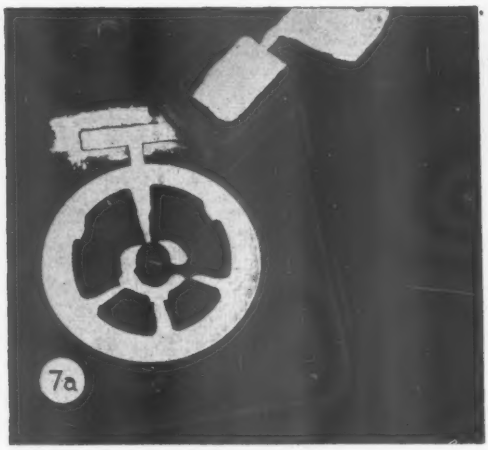


FIG. 7 (*a*).—*Series VI (1)—Square Direct Ingate Directly Opposite the End of a Spoke.*

any slag or dirt can flow by the ingate or lodge safely at the end of the runner-bar.

(3) Tangential forward entry. The metal flow-pattern conforms to that expected and shows clearly the undesirability of cutting the ingate in this way, relative to the direction of metal flow. Obviously any sand or slag floating on the metal stream is almost bound to find its way into the mould. It will be readily realized that too often is this form of runner found on multiple-casting pattern plates (Fig. 4).

(4) Tangential backward entry. The advantages of this type of gate over the preceding type from the point of view of slag- and dirt-entry prevention is obvious, but from the standpoint of even temperature gradient in a plate-type mould it does not compare with preceding or succeeding shots.

(5) Multiple-ingate entry (Fig. 5).—In this case, three small rectangular equal-size ingates were taken off the runner-bar. It will be noted that the ingate nearest the runner bush runs last. This is, of course, general knowledge amongst founders, and has led to suggestions to reduce progressively the sizes of ingates in order to get an even rate of flow through each ingate. Whether this is necessary in practical gating, where a relatively short time is needed to fill a mould, is debatable. In any case, this effect is caused by the position of the downgate along the runner-bar relative to the ingates, as will be noted in the next paragraph.

(6) Two downgates at end of runner-bar, downgate central.—It is clear that a fairly even flow-pattern results (Fig. 6).

SERIES VI

Gating a spoked-wheel mould.—The shape was chosen to represent any type of circular casting having arms or spokes, of fairly thin section, and having a thicker-section outside rim, such as would be found in grooved pulleys, gears, flywheels, etc.

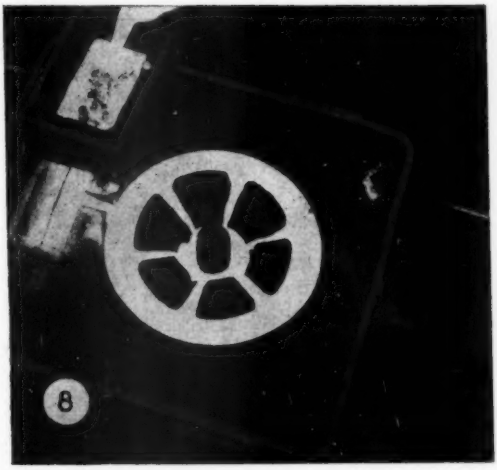


FIG. 8.—*Series VI* (2)—*Gated on the Rim between Spokes.*

In the case of such castings it is essential that correct temperature gradients be established when the mould is full of metal so as to avoid cracking or distortion in the casting as it cools down to normal heat.

The most usual case is where one or two arms may be filled last, and crack away from boss or rim. Filling the boss and arms and flowing around the rim may produce a crack in the rim, or, in an extreme case, a misrun casting. The cored boss may solidify, relatively, a considerable time after the arms and rim, and exhibit more or less excessive porosity. The proper placing of an ingate on such a casting then becomes a matter for more

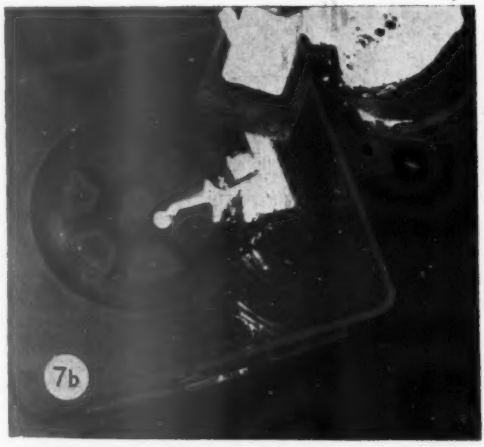


FIG. 7 (*b*).—*Series VI* (1)—*Early stage in Running. Square Direct Ingate, Directly Opposite the End of a Spoke.*

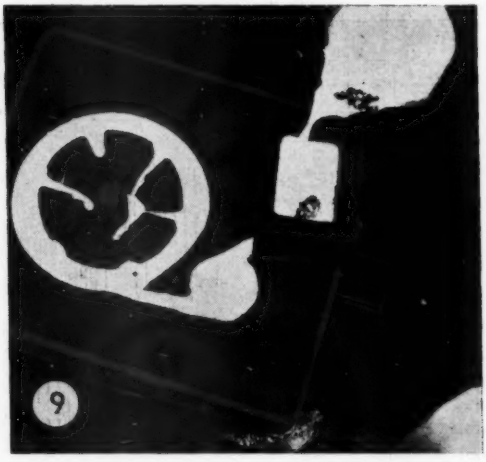


FIG. 9.—*Series VI* (5)—*Whirlgate in between Downgate and Ingate.*

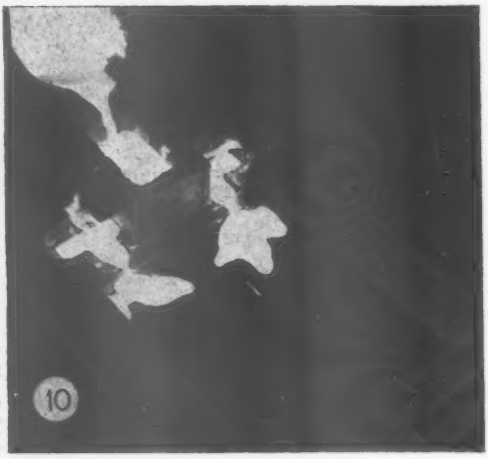


FIG. 10.—*Series VII* (1)—*Two Ingates poured from One End.*

consideration than the mere filling of the mould cavity with molten metal.

(1) Square direct ingate directly opposite the end of a spoke. Higher velocity metal from an ingate of normal height would pitch metal directly into the arm nearest the ingate and thus spread the first metal between boss, arm and rim. In the illustration this clearly does not happen, owing to relatively slow-velocity of the metal (Figs. 7 (a) and (b))

(2) Gated on the rim between spokes. The rim fills first and then each arm fills and the boss last, thus producing a more even cooling gradient. Should gear teeth be cut out of the rim, there is less likelihood of porosity at the tooth root with this method, than where the ingate and arm may cool off, opposing each other through the thicker rim. (Fig. 8.)

(3) Single tangential entry.

(4) Double tangential entry from a square runner-bar.

(5) Whirlgate in between downgate and ingate. (Fig. 9.)

(6) Horn-gate direct from downgate into central boss.

Differing metal flow-patterns are apparent in each of the cases cited in this series. Obviously, each method is efficient and effective as an ingate to such a type of mould and the choice of which shall be used would be dictated by the moulding method used, or by the relative thicknesses of metal sections in rim or boss, in order to get the last feed metal where it is most required. Obviously also, the use of a direct-entry horn-gate demands the use of a good clean runner-basin, and clean pouring technique.

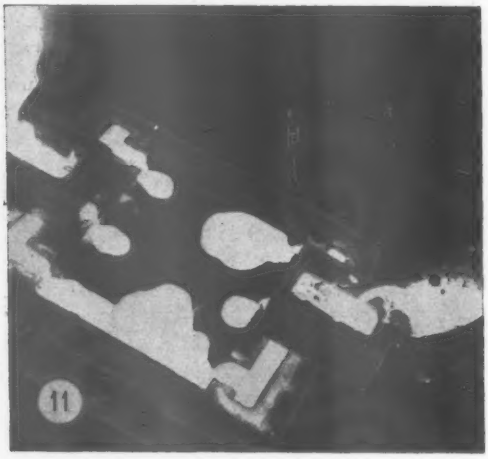


FIG. 11.—*Series VII* (2)—*Three Ingates poured from Each Side.*

SERIES VII

Metal patterns in a simple rectangular plate.—In this case, limitations of equipment dictated that a relatively small plate should be used, but an attempt was made to portray the flow-patterns that would exist in a larger flat plate, representing such castings as marking-out tables, machine-bases, milling-machine tables, and similar types of castings. The actual plate size used was 14 by 11 by 1½ in. deep. The runner-bar had 1½ by 1½ in. cross-section and ingate size was 1½ by ⅞ in., downgate, ¾ in. dia. This meant a ratio of approximately:—Downgate : runner-bar : ingates of 1 : 4 : 2½, in the first plate gated one end, and 2 : 8 : 7½ in the second and third cases of the moulds poured both ends, showing clearly that the metal flow-pattern produced was controlled in each case by the downgate area and not by the ingates.

(1) Two ingates poured one end (Fig. 10).

(2) Three ingates poured each side (Fig. 11).

(3) Three ingates poured each end.

SERIES VIII

Flow-patterns in simple, circular-shaped moulds with a direct-entry ingate.—In this series, slight modifications to the bottom shape of a simple circular mould were made; the similarity of such shapes to normal type moulds is readily apparent. In every case, the same size ingate 1 in. deep by ½ in. wide was used, directly connected with a ¾ in. dia. downgate (*i.e.*, no runner-bar). In such cases, any poor pouring practice, such as allowing the level of metal in the runner basin to fall below a reasonable minimum height of three times the downgate diameter, would allow scum, dirt and slag to enter the mould. In some cases, this was allowed to happen and scum is apparent on the metal stream in the photographs.

(1) Plain, circular, flat-bottom plate. Turbulence is apparent due to hard ramming.

(2) Circular plate with dropped centre section, same ingate. Note the sand washed off the edge of the depression (Fig. 12).

(3) Circular plate with raised centre section.

(4) Circular plate with raised bead and dropped centre, direct entry, same ingate (Fig. 13).

(5) Circular plate with dry-sand bottom (Fig. 14) (compare with (1)).

(6) Circular plate with oil-sand-core bottom. Some flame and smoke evident.

SERIES IX

Effect of Metal Temperature

(1) Green-sand square plate; metal poured " hot " (*circa* 1,420 deg. C.), through direct-entry spoon-gate (Fig. 15).

(2) Green-sand square plate; metal poured " cold " (*circa* 1,310 to 1,320 deg. C.). Same-size ingate (Fig. 16).

SERIES X

Effect of Various Metals on Flow-patterns.—In all the foregoing series, the metal used to show flow-patterns was grey cast iron. This was chosen more because of the operational facilities available to the sub-committee than for any other one particular reason, for it had been determined that the behaviour of practically all of the common casting metals in the fluid state (provided casting temperatures were high enough to give good fluidity) showed marked similarity of flow-pattern. In this series, also, was included two shots of the flow-pattern of a 0.3 per cent. carbon steel cast " cold," which behaves similarly to the preceding " cold " cast iron in Series IX.

(1) 0.3 carbon steel cast " cold."

(2) 0.3 carbon steel (10 per cent. superheat).

(3) Cast iron in the same mould for comparison.

As the moulding sand in this series had been altered to a steel-moulding type of sand, it was thought desirable to include again a cast iron to show that the sand used had no material effect on the pattern produced.

(4) Gunmetal, of the usual 85/5/5/5 type, representing the brasses and bronzes. Note the extensive zinc fumes from the metal.

(5) " Y "-alloy, representing the aluminium-alloy group. Even with the apparent high surface tension of this metal, its flow-pattern (directly to the furthest part of the mould from the ingates, filling the corners nearest the ingate last), is similar to all the other metals poured hot enough for good castability.

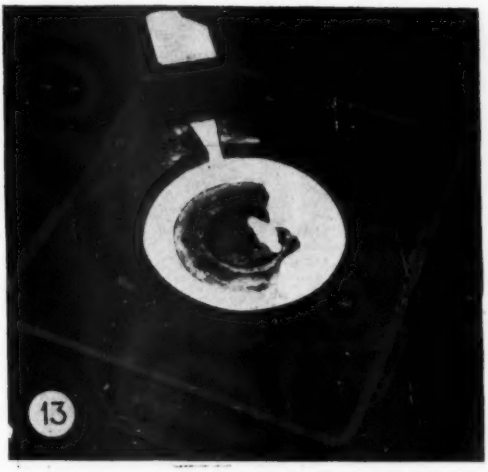


FIG. 13.—*Series VIII* (4)—*Circular Plate with Raised Head and Dropped Centre.*

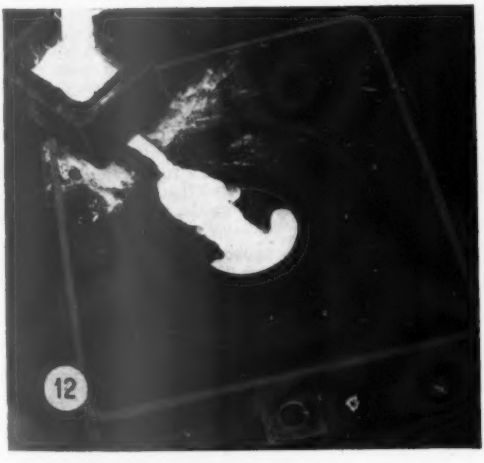


FIG. 12.—*Series VIII* (2)—*Circular Plate with Dropped Centre Section.*

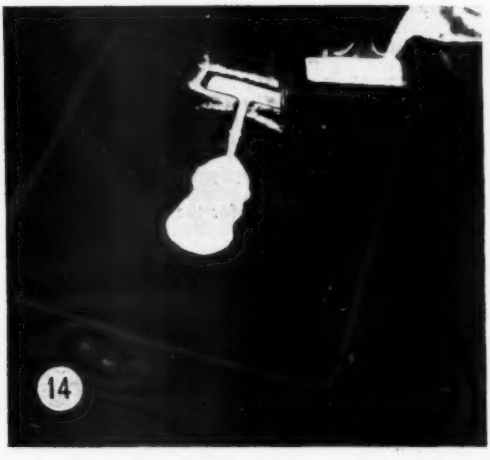


FIG. 14.—*Series VIII* (5)—*Circular Plate with Dry-sand Bottom.*

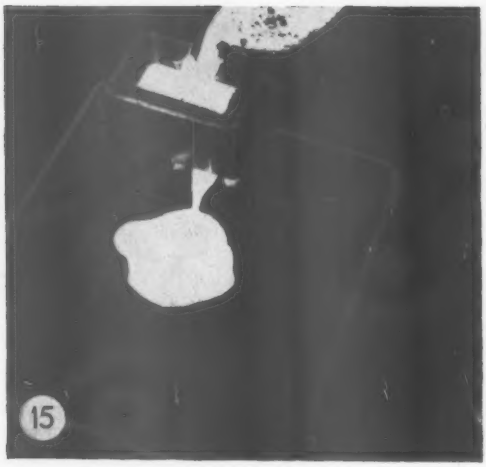


FIG. 15.—*Series IX* (1)—*Green-sand Square Plate. Metal poured "Hot."*

FIG. 16.—*Series IX* (2)—*Green-sand Square Plate. Metal poured "Cold."*

Conclusion

In conclusion, the sub-committee would like to express their appreciation to the Butterley Company, Limited, for the facilities granted to take the film and photographs in the Meehanite Apprentice Training School, and to the apprentices and school instructor, who made and poured all the moulds, except those in Series X, which were prepared and cast with assistance from the Mond Nickel Company's laboratory, to whom due acknowledgment is made.

REFERENCES

[1] S. L. Fry. Preliminary investigations of metal pouring by Ciné Radiography. FOUNDRY TRADE JOURNAL, July 12, 1945, p. 213.

[2] Johnson and Baker. A.F.S. Transactions, 1948.

[3] Swift, Jackson and Eastwood. A.F.S. preprint No. 49/55, A.F.S. Annual Meeting, May, 1949.

[4] Currie. Running and Risering Iron Castings. Proceedings, I.B.F., 1941-2; p. 226, *et seq.*

[5] Tedds. Flow of Metal through Runner Systems. FOUNDRY TRADE JOURNAL, April 27, 1950; p. 443.

[6] Johnson, Baker and Pellini. Principles of Gating. *The Foundry*, October, 1948; July, 1950.

Dowlais Foundry

The making of castings on the site of the Dowlais foundry reaches right back to the beginning of the iron foundry industry. Consequently, there is a cadre of highly-skilled craftsmen available in the area, well capable of making a serious contribution to the development of a local modernized iron castings industry. To this end, the Company is spending £250,000 on a scheme which has every appearance of producing a foundry of which South Wales can be justly proud. So far, a high, well-lighted, modern building has been provided, laid out, and equipped to produce ingot moulds and other castings demanding hematite iron and high-class grey castings for the machine-tool trade and general engineering industries. The existing cupola plant is to be augmented by new furnaces on the opposite side of the foundry. This will enable the hematite work to be separated from the grey-iron castings production. The total melting capacity is such that the foundry will be able to produce about 500 tons per week. All the cupolas are mechanically charged.

There is an automatic sand-preparing and distributing plant by August's Limited, which services four knock-outs strategically placed about the foundry and three "Foundry Equipment" sand rammers—two "Juniors" and one "Senior" at the general moulding stations. For the handling of such weights as are to be associated

(*Continued at the foot of col.* 2)

with ingot-mould manufacture and the like, reliance is placed on electric overhead travelling cranes.

The drying of the moulds and cores is carried out in a battery of mould- and core-stoves installed by Modern Stoves & Furnaces Limited. The chemical and sand laboratories are also being re-equipped.

James Watt Engine

The James Watt beam engine, which has been in use for about 140 years and is still in service with the Harts Hill Iron Company at Brierley Hill, had its first major breakdown on June 12. The cause of the trouble was a fracture in the cast-iron main beam, which severed the link with the cylinder head and broke the supporting arms.

This famous old engine was bought second-hand by the firm a century ago and, with an almost perfect performance, has been used to drive a rolling-mill producing steel bars. Now it is anticipafed that there may be some difficulty in repairing it, since the arms need to be of knot-free pitch pine 39 ft. long and 4 inches square.

The engine develops approximately 900 h.p. and has a cylinder over 48 inches in diameter with a 9 ft. stroke. It has been much admired by many visitors, several from America who have offered to supply a new power unit on condition they be allowed to take away the historic Watt engine.

Book Reviews

The Story of the Mushets, by Fred M. Osborn. Published by Thomas Nelson & Sons, Limited, 3, Henrietta Street, London, W.C.2. Price 21s. net.

Very complete biographies have been published of Bessemer, Siemens and other outstanding pioneers of the "Steel Age." To this galaxy of talent the late Mr. R. F. Osborn in this volume adds Robert Forester Mushet, who was a contemporary and very capable metallurgist with a bent towards experiment with alloys such as manganese, tungsten, chromium, and titanium. The work is described of the two Mushets, David (the father) and Robert (the son), but it is Robert, whose research was of much greater value, and the author pays due tribute to his discoveries on self-hardening and other alloy steels. Mushet also experimented with spiegeleisen, having heard of good results secured in Germany in crucible melting. Thereafter Mushet pursued Bessemer with bitter criticism, the gravamen of his complaint being that Bessemer was using his process without acknowledgment, and rather gradiloquently he always referred to the Bessemer-Mushet process. After the lapse of 100 years it is not profitable again to discuss at length this dispute. However meritorious Mushet's work may have been, he allowed his patents to lapse. Bessemer, in his autobiography in referring to managanese, lists some 20 patents covering its use taken out between 1800 and 1856 by different patentees. Even if Mushet's patents had been renewed, it by no means follows that they would have been held valid in the law courts. Mushet was not a success at business and, with the exception of Samuel Osborn & Company, Limited, who linked up with him on self-hardening steels, was unable to secure adequate support from the industry. As an American writer put it, he delighted in controversy and possessed a complete command of language of the *aquafortis* variety. Bessemer, on the other hand, essentially an inventor, had a balanced mind, was a judge of men, and obtained and retained the confidence of leaders of industry on both sides of the Atlantic. About one-sixth of the text is devoted to Mushet's letters, mainly an acrimonious exchange in 1884 in the trade Press with W. T. Jeans, an able Fleet Street journalist,' but from a technical standpoint not worth powder and shot. He is not to be confused with J. Stephen Jeans, who had an international reputation in the trade as an authority. These letters and the inclusion of American claims that Kelly anticipated Bessemer are only remarkable for their verbosity and might well have been omitted. They savour of an attempt to discredit Bessemer's work. Mushet's achievements are a sufficient monument to him without such adventitious aids. Industry has always been honeycombed with ideas of disputed origin, but to develop them all requires much time and ingenuity from every branch of the engineering profession as well as chemists, physicists, and other scientists. Clerk Maxwell invented radio, but it was Marconi that made its use practicable after years of work. Hall in America and Héroult in France simultaneously invented the electrolytic process for the production of aluminium. In such cases a fair apportionment of credit is not easy, but surely the greater part must be given to those who render useful to mankind ideas often incomplete or vague. Assisted they usually are, but the so-called back-room boys are numerous and necessarily for that reason nameless.

H. J.

Tungsten, by Colin J. Smithells, M.C., D.Sc. Published by Chapman & Hall Limited, 37, Essex Street, Strand, London, W.C.2. Price 75s. net.

The third edition of Dr. Smithells' well-known treatise on tungsten has now been published after a lapse of 17 yrs since the second edition (1935). So greatly has the subject expanded in the interval that the author has found it expedient to enlist the assistance of experts in the various fields. The result is very satisfactory, being a volume which embraces all phases of the subject ranging from the history of the element, the mineralogy of its ores, the methods which have been used for extracting and purifying tungsten trioxide and the methods of reduction to metallic tungsten with detailed descriptions of the variations in technique which have to be made according to the use for which the metallic tungsten powder is intended.

As the Author has been so closely associated with the production of tungsten wire for lamp filaments, it is natural that this field should comprise a great deal of the book and that the metallography and physical properties of wire produced under various conditions should be dealt with at great length. High-speed steel and cemented tungsten carbide are given fair attention, whilst the concluding chapters deal with analytical methods of determining impurities including spectrographic techniques. Finally, as an appendix, appears a facsimile of Wolfram Ore Contract A.

It is difficult to offer criticism of such a commendable work, but the reviewer is disappointed to find no reference to those tungsten/copper alloys known under the trade name of "Elkonite" and that room was not found to include a reproduction of Wolfram Ore Contract C. British specification. The volume is a valuable addition to all metallurgical and chemical libraries bringing together as it does a mass of information not otherwise available in one volume in the English language.

G. F. W. P.

Fruitful Heritage, by Ernest Allison. Published by Roylee, Windsor House, Victoria Street, London, S.W.1.

The Lloyd family have made and are making a serious contribution to the development and welfare of this country. They are a very old family and the Author has picked a few of the more outstanding personalities and recounted something of their characters, their surroundings, their ambitions and attainments. The book is very readable, with this quality notably improving as the story unfolds itself. In the earlier chapters, there are several unnecessary repetitions of information. Such actions are known in the cinema world as "flash backs," but these have no useful place in biography. The book, however, has cleared up in the reviewer's mind and no doubt in the minds of many others, the fact that Lloyds Bank: F. H. Lloyd & Company Limited: Stewarts and Lloyds and Lord Lloyd—"the last of the great proconsuls of the British empire" emanate from the same stock." Whilst the reviewer holds that an excess of annoted references generally detract from ease of readability, yet in this case he thinks the inclusion of a selected bibliography would have been appreciated by the more studious, as also would have been the addition of an index.

V. C. F.

THE PRODUCTS of the general rubber goods division of the Dunlop Rubber Company, Limited, reached more than 100 countries last year, Sir Clive Baillieu, chairman of the Company, told shareholders at the recent annual general meeting. Their value was 45 per cent. up on the year before, and total sales were up by 49 per cent. The Company was now producing more than 3,000 rubber articles for industrial, domestic, and military purposes, he said.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

SAVING *UN MILLIARD*

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Your leader of June 5 is extremely interesting, as indeed anything that helps to save *un milliard* must be, but I do not feel that the opportunity should be lost, of both stimulating more constructive thought on the policy underlying your article, and also of putting forward the view of the small foundrymen, who cannot afford to run an expensive laboratory.

During the visit by the London branch of the Institute of British Foundrymen to the Ardennes Foundries, who were members of the *Syndicat des Fondeurs sur Modèles des Ardennes*, we had the opportunity to inspect their co-operative laboratories, and it was brought home to all of us how important was the work of the *Centre Technique*, but also that it is imperative to have the laboratory either in your own works or on your doorstep.

The Ardennes group are obviously connected with the *Centre Technique* in Paris, but the establishment of a local laboratory furnishes the founders with reports of tests within 24 hours of receiving a problem. It was in fact their proud boast that they have got results in six hours, so that the foundry may take action when preparing the next cast.

I understand that the Ardennes Regional Laboratory deals with approximately 400 foundries, while the British Cast Iron Research Association cover the whole of the country, which I believe operates nearer 2,000 foundries (if they are all members) in addition to dealing with the wider aspects of technological research which is the central organization's function. While we have always received the greatest help and understanding from the B.C.I.R.A. it does usually take two or three weeks before a result of a test can be obtained.

I would, therefore, sum up by giving four points which would certainly help to save a second £1,000,000, if indeed the first has been saved:—

(1) The setting up of regional laboratories, which will attend to the daily needs of foundries, dividing the country into regions of 400-500 foundries per region. There is no fundamental reason why such laboratories could not deal with the non-ferrous side also.

(2) The allocation of funds to these regional laboratories from the central research associations funds, or raising more on a pig-iron or ingot levy.

(3) Less paper! We get too much paper to read. Surely the employers and research organizations could discriminate more as to who needs certain documents and thereby save money.

(4) Educate foundrymen by practical demonstrations how to use these laboratories and technical resources to the benefit of their business and the industry as a whole.

Yours, etc.,

A. R. WIZARD,
General Manager,
S.E.M. Limited.

Pitsea Street, Stepney, E.1.
June 12, 1952.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Your leader of June 5 touches upon a matter that is occupying the minds of many non-ferrous foundrymen at the present time. Our approach in this country to this aspect of research is out of all proportion to its importance. The British Non-Ferrous Metals Research Association in this respect are rendering inestimable value to the foundry circles, but owing to the limits to which they are confined, the immediate advantage of their work is denied the industry generally. There are, of course, those larger foundries with their own research organization, but, apart from these and the handful of public-spirited men whom one meets round the technical committee table so often and in such a wide range of foundry subjects, whose work carries them well within the precincts of research, there is nothing organized from the point of view of a national non-ferrous foundry industry. The aggregate of the research work done through the more or less haphazard approaches is, through duplication and presumably owing to lack of finance of the individual, by no means commensurate with the total time and effort thus expended.

For either a long- or short-term research programme, and in my opinion both are essential, finance is necessary, and as the benefits of the research should be available to all within the industry from the largest to the humblest foundry, it follows that it should be financed on a national basis. We have ample evidence that such a scheme is possible from the success of the pig-iron levy in this country, as well as from the non-ferrous castings levy in operation by our colleagues across the Channel.

We are always interested in the expounding of academic theories, but we are first of all interested in research matters on the foundry floor. The amenities should be available to all for the investigation of day-to-day production problems on a day-to-day service. Mr. T. H. Summerson added weight to this need when he said, in the course of his speech at the I.B.F. banquet at Buxton last week, that when the bell tolled for one faulty casting it did so also for the casting industry. Furthermore, a paragraph in the daily Press appearing recently concerning the failure of a national sports-machine on account of so-called faulty castings, should either have been authoritatively refuted immediately or alternatively should have been authoritatively obviated in the castings in the first place.

Several groups of foundrymen are sufficiently interested in research and in the financing thereof to have got together recently. I personally wish them all success and hope that the saving of *un milliard*, whether in foreign exchange or in sterling, will be a thing of the very near future.—Yours, etc.

W. G. MOCHRIE.

Tyseley Metal Works Limited,
Balfour House, Finsbury Pavement,
London, E.C.2.
June 16, 1952.

Forty Years Ago

In our issue of June, 1912, there is an illustrated description of a foundry, and if it was typical of the period, then to attain increased productivity must have been relatively easy. It shows untidy shops which by modern concepts could work efficiently with half the staff. However, one never knows whether or not in those days the staff came in from other departments just to be in the picture. In general, the issue is a fairly poor one from a modern point of view. Much space was devoted to the grading of pig-iron by fracture. There were, however, a few good practical Papers. Amongst the business notes is one recording the sale of the steel foundry operated by the British Westinghouse Electric & Manufacturing Company, Limited. The formation of the British Engineers' Association was reported.

B.I.S.R.A. Research on Foundry Matters

Post-war metallurgical research in Britain has been energetically developed, and is of a high order. Co-operative research has given consistently useful results, and the achievements in the past year have been gratifying and augur well for the immediate future. In this connection, the British Iron and Steel Research Association's annual report of Council for 1951 *serves to review current research and development programmes, and information on such of their work as concerns foundrymen is contained in the abstracts below.*

Blast-furnace Operation

A technique has been developed for exploring the tuyere region of blast furnaces by stereoscopic photography. By using a modified tuyere door with two windows and a picture-splitting unit, two pictures may be taken on each frame of a high-speed ciné film; this film may then be viewed using either prismatic spectacles or polaroid glasses to give a picture in exaggerated relief. By showing the film in slow motion, the motion of solid particles in the combustion zone may be followed. Photographs have been taken through the tuyeres of furnaces at the Shelton Iron, Steel & Coal Company, Limited, and the Steel Company of Wales, Limited. A special technique is being worked out for the analysis of these films, in order to determine accurately the sizes, size gradings, distances from the tuyere, rate of diminution and velocities of the particles of coke and other materials.

A periscope has been produced for inspecting the condition of the wearing plates of a blast furnace. It contains a built-in lamp which illuminates its field of view. The periscope may be lowered through a stock-rod hole when the wind is off the furnace.

A further development is the use of radioactive cobalt as a tracer by embedding active pellets in ore lumps at various furnaces. The appearance of activity in the metal at cast time makes it possible to estimate the burden transit times. Also, by using gaseous radioactive tracers, estimations can be made of the leakage of air at the change-over valve of an open-hearth furnace. By injecting radon into the uptake, the percentage volume of air that leaks across the valve has been estimated and further experiments are planned to estimate the total loss of inlet air and the volume of air that infiltrates into the bath and ducts system of the furnace.

Some calculations of heat flow through carbon hearths have been made and correlated with temperatures taken since blowing in from thermocouples under the 25-ft. 9-in. hearth furnace of the Steel Company of Wales, Limited. The expected temperature gradients and distribution under hearths of proposed new furnaces have been calculated. This work has emphasized the high temperatures which may be obtained, with possible danger to the furnace, both in and below carbon hearths if there is no deliberate extraction of heat from below. Calculation shows that adequate thermal control could be secured by air cooling, and a furnace in Austria which is water-cooled below the hearth is operating satisfactorily.

The Blast Furnace Refractories Joint Committee of B.I.S.R.A. has been examining blow-out furnace linings. Recently, several carbon hearths have been investigated and it is suggested that infiltration of air or steam from the foundations may produce, in the hearth, oxidation of the edges of carbon blocks, which are then readily loosened and able to float up into the metal. Results from ferro-manganese furnaces have shown that ferro-manganese metal in the hearth or in impregnated bricks is readily oxidized. When bricks are impregnated with metal, oxidation causes severe distortion of the bricks; this may explain the several recorded instances of ferro-manganese furnaces rising from their foundations.

The catalysis of carbon deposition and the mechanism of the reaction are being systemically examined. The work has shown that high-temperature firing of bricks has two effects which reduce the disintegration of refractory materials caused by carbon deposition. These are the neutralization of active iron spots by causing the iron to combine with alumina and silica, and the increase in the structure density of the brick; this increased density may help to localize the spread of disintegration to small areas.

Steel Making and Treatment

Increased attention has been given to problems arising from the diminished scrap supplies available in this country. The relationships between the amount of slag formed and the pig-iron to scrap ratio on one hand, and the composition of the materials on the other, have been studied and their general trend has been established. The difficulty of meeting low-sulphur specifications in the open-hearth furnace arising from the use of higher pig-to-scrap ratios has been emphasized and has led to the considêration of a number of possible modifications in iron and steel refining. Particular attention has been given to active and inactive mixer operation, the desulphurization of pig-iron and pre-blowing methods of desiliconizing pig-iron. Data from a number of active and inactive mixers have been studied statistically to see what relationships exist between such variables as amount of atmospheric oxidation per unit of throughput, mean time in the mixer and the amounts of silicon, sulphur and phosphorus removed. One conclusion was that the amount of agitation which occurs, *e.g.*, that caused by metal additions, is more important than the time the metal is in the mixer. It was also evident that conditions favouring sulphur removal do not favour silicon and phosphorus removal.

A big variation in the amount of sulphur removed in various inactive mixer practices has been revealed.

B.I.S.R.A, Research on Foundry Matters

In some instances it was less than 10 per cent. and in others as much as 40 per cent. As might be expected this appears to be associated with the manganese content of the iron and also with the presence of soda ash from the pre-mixer treatment. This aspect of mixer practice is to receive further study.

Ingot Moulds

A micro-examination has been made of samples taken from two 10-ton ingot moulds, one of which was used throughout its life of 208 casts with short tap-to-strip intervals and developed a "projected" type of crazing, while the other was used throughout its life of 115 casts with long tap-to-strip intervals and developed a "depressed" type of crazing. The examination revealed that the former is associated with growth at the inner surface and the development of an open network of deep cracks, and that the latter is associated with severe oxidation of the inner surface and the development of a close network of shallow oxide inroads. The difference in mode of formation is explained by a consideration of time and temperature effects each time the moulds were used, rather than by the difference in total lives of the moulds.

Two projects of the Ingot Surface Defects Subcommittee, which was dissolved early in 1951, have been taken over by the Rolling Ingots Subcommittee. One concerns the effect of mould wear on ingot quality, and works trials will be made to determine the effects of worn moulds on the quality of rail steels. On other types of steel the Subcommittee feels that worn moulds have no adverse effect, provided that the mould surface is not so badly damaged as to cause "sticker" ingots. The second project is the study of the cracking of steels. Earlier laboratory work indicated that steels in the intermediate carbon range, 0.18-0.25 per cent. were less prone to cracking than low or high carbon steels and this appears to be contrary to general practical experience. Works data are therefore being examined to determine whether carbon content and tendency to crack are directly related as cause and effect.

One firm has made an ingot casting experiment in which two ingots were direct-teemed from the same ladle, one into a normal mould and the other into a special mould which was refractory-lined in the top half and set on a heavy cast-iron bottom-plate. The most pronounced difference in structure was the presence of V-segregates and relative absence of A-segregates in the normal ingot, and the reverse in the special ingot. Subcutaneous segregates, thought to be associated with the condition of the mould surface, were present in the chill portion of both ingots. The trial is to be repeated, paying particular attention to the mould surface; later, up-hill casting will be considered.

Metallurgy of Coatings

The properties of a metallic coating produced by hot-dipping depend on the composition, the amount and distribution of the intermetallic alloy phases formed by interaction between the iron and the coating metal. Two methods have recently been used for identifying the various iron-zinc phases present in a hot-dipped galvanized coating. The first is colour photography in which the selective colouring of the different phases is reproduced by a special etching reagent. The second is microhardness testing which enables hardness determinations to be carried out on each of the components present in a cross-section of the coated specimen.

The properties of electro-deposited coatings depend to a great extent on the crystal structure of the deposit in relation to that of the steel substrate. In practice, electroplating is done on a polycrystalline substrate, but the principles of crystal growth are more easily studied by investigating deposition on single crystals. Most of the work which has been done by means of electron diffraction has been confined to the deposition of face-centred metals on face-centred single crystals. Work has been started at Sketty Hall, Swansea, to study the deposition of a metal having a different structure from that of the substrate; body-centred iron single crystals have been plated with metals such as zinc, which has a hexagonal structure.

Technological Education

The Government considers that a most important means of increasing productivity in industry is to improve the facilities for higher technological education. In a written answer to MR. G. LONGDEN, the CHANCELLOR OF THE EXCHEQUER said that the Government was convinced that this could best be done by building up at least one institution of university rank devoted predominantly to the teaching and study of the various forms of technology. He was, therefore, urgently exploring the practical possibilities to see the best way of doing this.

"As regards the last Government's White Paper, I should say that we fully recognize the important contribution which some technical colleges can make to higher technological education, and details of our proposals for making improved financial assistance available for selected colleges and courses therein will be announced shortly." MR. BUTLER added that the Government did not, however, propose to establish a non-teaching, award-making body under the title of the Royal College of Technology.

On the following day, MR. MORLEY asked the Minister of Education what her plans were for the development of higher technological education in England and Wales.

After referring to Mr. Butler's statement, MISS HORSBRUGH added that she would be announcing very shortly her detailed plans for giving improved grants for certain courses in technical colleges in which provision was made for higher technological education.

In a written answer to MR. M. MACPHERSON, who asked what changes in policy she contemplated in consequence of the recommendations contained in the Fifth Annual Report of the Advisory Council on Scientific Policy (1951-52), MISS HORSBRUGH said she hoped that the improved grants which she was offering to some technical colleges would enable those colleges both to improve their courses and to increase their output of well-educated technologists. It was too soon to say what further steps she would wish to take in this matter or on any other recommendations of the report which were her concern.

Probable Trends in British Steelfoundry Practice*

By F. Cousans, F.I.M.

There was a frank exchange of ideas and information by steelfounders during the last war, and since that war ended there has been the visit to the United States by a British Steelfounders' Productivity Team and also productivity conventions organized by the British Steel Founders' Association. There is now a real progressive spirit in the industry, and therefore it seems fitting that consideration should be given to the practices likely to be employed in the future. It is hoped that these notes may be of help in stimulating a discussion which will be of assistance to the younger members of the industry.

Steelmaking

The basic electric furnace and the acid, side-blown converter processes, are the ones in most general use among British steel foundries. The open-hearth (acid and basic), and high-frequency furnaces are also used, the latter process being largely employed for special steel casting production including heat- and corrosion-resisting qualities.

The serious shortage of steel scrap of suitable sizes and qualities is a serious problem to the steelmaker, and this shortage appears likely to persist for a number of years. The steelmaker using the electric process is therefore likely to be compelled to continue to use the basic process, which ensures the production of high-quality steel of low sulphur and phosphorus contents. Nevertheless, the Author feels that when a supply of good scrap (low S. and P.) becomes available, some steel foundries in this country will change over from the basic to the acid electric process. The acid electric process will enable a more rapid production of steel of the plain carbon types.

The high cost of electric power creates a serious problem to the user of electric-arc processes, and in the writers' view extensive use of the oxygen lance for the elimination of carbon, silicon, and phosphorus, will be made. This will result in a reduction of the time taken for the first part of basic electric heats and a saving in power costs, and indirectly lead to an increase in the steel output. It seems therefore worthwhile to concentrate on the second part of basic electric heats, to see what can be done to produce, more quickly, reducing slags. Some steelmakers add calcium carbide along with the lime and spar, to help to bring about reducing conditions quickly. In the Perrin process, it has been seen how quickly it is possible to make steel of high quality by mixing together a synthetic slag of suitable composition and metal, or steel, and it would appear that if ways and means could be found of producing and pouring to the basic furnace, synthetic slags of suitable composition to heats of steel ready for final sulphur reduction and deoxidation, then the time needed for the second portion of heats could be greatly reduced.

* Paper presented to the Buxton Conference of the Institute of British Foundrymen earlier this month.

Other Melting Factors

The Productivity Team drew attention to the practice in the United States of employing transformers of greater capacity on electric-furnace plants used for steel casting production, and there is little doubt but that new plants put down in this country will include larger transformers than have been customary to date. The use of furnaces with swinging roofs, which permit of basket charging is likely to increase and, in the Author's view, rammed furnace roofs are likely to receive much more attention and trial. The storage of all materials for steel making under cover offers great advantages to the quality steel producer, and this practice is likely to become generally adopted.

In mechanized steel foundries, producing carbon steel castings, it would be advantageous to have steel "on tap" thus permitting continuous casting. The use of a holding furnace in which liquid steel is kept at a suitable casting temperature and composition, is very valuable where continuous casting is desired. The steel for transfer to the holding furnace can be produced either in electric-arc furnaces, or in side-blown converters, and it is felt that some of the new mechanized foundries are likely to include one or more holding furnaces as part of the set up.

The side-blown converter process is seriously handicapped by the present shortage of, and cost of, good-quality melting coke as well as of suitable steel scrap. The use of the hot or warm blast cupola and the use of oxygen-enriched air blast are likely to be developed and applied to cupolas used for producing metal for subsequent conversion in side-blown converters. The metallic losses due to mechanical reasons is likely to cause attention to be given to the internal shape and sizes of side-blown vessels, and in the Author's view, great economies are possible in this connection. The use of oxygen-enriched air blast has now become established, thus permitting the very rapid production of steel by the side-blown process, and it seems natural that this practice should be extended. The fettling and patching of cupolas and of converters is an expensive matter and one which calls for mechanical aids in the form of guns or sprays for the application of the patching material.

Probable Trends in British Steelfoundry Practice

As the mechanization of foundries extends, it is felt that the steelmaking sections will be regarded as service units to the foundry, producing when and what the foundry require and generally working in the direction of smaller heats at very frequent intervals, or what seems most desirable, steel "on tap" from holding furnaces.

Sand Practice

There has been seen during recent years a steady changeover in the sand practice in British steel foundries from the use of naturally-bonded sands to a greatly increased use of synthetic sands, and it seems clear that this change is likely to continue. It will be conceded that there are some disadvantages even with sythetic sands, air drying being one of the problems associated with its use.

The report of the Productivity Team drew attention to the use of finer sands in the United States than are normally used here, and it is felt that many steel foundries here will ultimately change to the use of fine sands. Recent research work at Cambridge has demonstrated that metal penetration and burning on, can be reduced by the use of well-rammed moulds made of sand of high packing-density, and in the Author's view there will be developments in the use of fine sands of mixed grain size.

According to published data, some use is made in the United States of silica-flour as an addition to sand mixtures to prevent metal penetration and burning-on. There are in this country silicious clays which could be used as bonds for moulding sands and which would probably give results as good as with the American mixtures.

In some steel foundries there is a serious lack of sand-preparation equipment and capacity, and omissions such as these must be corrected. The need for adequate cooling facilities for sand is now generally realized. The sand plants of the future will probably include sand driers, coolers, storage hoppers, mills or mixers, screens and magnetic separators and de-silting equipment.

Sand-to-metal ratios of from 7 to 1 to 5 to 1 by weight have been quoted as being representative of average steelfoundry practice. Consideration of these figures will emphasize the importance of efficient sand distribution, so that the necessary quantities of sand can be distributed to the working points during normal working hours. The absence of spillage or return-sand conveyors from the moulding points is a serious feature in many steel foundries, and this results in untidy and dirty floors. Defects such as these will be corrected.

Moulding

In many cases, it will be necessary to produce moulds by hand, but the moulders will be given all possible help in the way of facing or backing sand, boxes, chills, lifters and mechanical rammers. The shortage of adequate sand-preparation capacity in many foundries has been referred to earlier, and no doubt this shortage has delayed the use of Sand-slingers in this country, but it is considered that there will be a greatly increased use of Sand-slingers, both to aid the hand or floor moulder, and also to fill boxes used on machines. During the last war, the Sandslinger was used very successfully in the production of cast-steel bombs and manganese-steel track links. The Sandslinger when properly operated gives a uniformly-rammed mould, and the importance of this is now appreciated. In point of fact, the Sandslinger is superior in this respect to many moulding machines of the conventional type. In view of this, the industry is likely to see investigations conducted and development work initiated to improve the ramming efficiency of moulding machines.

An interesting development recently disclosed of producing moulds by blowing, is likely to be actively followed up and developed. It is the Author's view that the users of steel castings in the future will expect them to be produced to small dimensional tolerances in relation to the size, and in this connection the industry is likely to see greater stress put on the quality of moulding equipment and patterns. The use of light-alloy patterns, etc., is likely to increase—particularly for machine-moulding applications.

Coremaking

Core-blowing is now a well-established practice in many steel foundries for repetition core production, but it is considered that its use for jobbing work will be developed. The use of di-electric drying of plastic-bonded sand cores, is now well established for cores of suitable shapes and sizes in iron foundries, and it is felt that some steel foundries have a useful place for this system in their layout and practice.

"C" Process

The Author feels that the "C" process of shell moulding is capable of great development and application to steel casting production. The general principles of the process are fairly well known, but the foundry industry appears to have been slow in this country in developing it. It is understood that castings in steel up to about ¼ cwt. are now being produced regularly by this process, but it is felt that to obtain the maximum advantages it will be necessary to have a proper set-up, with full mechanical aids to assist each operation. The progressive foundryman will require the full help of the engineer to develop his processes in the future.

Cleaning and Dressing

Steelfounders are fully aware of the importance of reducing the dust hazard, and the Hydroblast has been developed with the object of assisting with this problem. A greatly increased use of the Hydroblast is to be expected, together with that of the split-roof type of Wheelabrator and of the barrel or drawn type Wheelabrator, for the initial cleaning of castings. The efficient collection of dust is a matter which will of necessity have to receive much attention in the future, and much research and experimental work will be required. The precipitation of dust by electrostatic and by

wet cleaning methods, is likely to be actively investigated and applied. The use of the powder-washing method for the removal of burnt-on sand has now become well established and its use is likely to increase. Many fettling and dressing shops could (with great advantage to all concerned) make much more use of mechanical aids. The use of fettlers' benches, lifting facilities, conveyors, burners, turntables, etc., are but a few that could be mentioned, and it is considered that very great attention will be given to fettling and dressing-shop layouts and practices in the future.

Materials Handling

A detailed study of the quantity of materials required to be transported for producing a ton of steel castings in an average steel foundry, shows that a considerable tonnage is in fact handled. Very great improvements and economies are possible in this connection. The ordinary rubber, sand-feed belt is just one example of how the engineer can handle large quantities of a particular material, easily and quickly. The mechanical handling teams which recently visited the United States have demonstrated the great use and attention given to handling devices and equipment in many American organizations. The Author feels that the problem of handling materials more efficiently is one of the greatest among those facing steel founders—and a very frank exchange of information and experience within the industry would be of inestimable benefit to everybody. Everybody is conversant with the use of Lister trucks but one steel foundry, at least, has used pallet plates and fork-lift trucks to move its castings from the foundry, and on through the fettling and finishing shops. The use of pendulum conveyors for the carrying of cores and moulding boxes in mechanized units is also well known, but in the average foundry the ideal method for moving moulding boxes, cores, etc., has yet to be devised. There is one great advantage resulting from the use of mobile units such as trucks, in that it is necessary for their efficient use to keep all pathways clear, and preferably to have a hard or concrete floor, and this enables one to keep the shop floor swept, clean and tidy.

Production Control and Planning

Many steel foundries are paying attention to problems of production control and planning and have installed systems. Attention was directed earlier to the needs of the floor moulder in that he must have his pattern made available, his boxes, sand (facing or backing) lifters, chills, nails, etc., at the right time, *i.e.* when he needs them, so that the casting which he is to make is moulded and cast in accordance with a predetermined plan, which aims to give the casting to the customer when needed. Before such control systems are installed, it is customary to make shop-floor studies of what is done and why, and frequently serious defects in the organization are thereby brought to light. It is felt that many of the problems which are revealed can be solved or assisted by the help of the production engineer. In view of the very progressive outlook now evident among steelfounders, it is safe to predict that much attention will be given in the future to this aspect of steelfoundry management and control, but it is felt that it will be necessary to train the staff and foremen in the use of such control systems.

Training Schemes

Many (it may even be true to say *most*) steel foundries, now have training facilities for apprentices. The general complaint seems to be the lack of apprentices to train, but given the right effort it is considered that this situation can be remedied. In the training of patternshop and foundry apprentices, it is considered good policy for there to be an interchange of boys between both sections—much good can result from such a practice. Some time spent on the steel-making units, in the sand laboratory, etc., can also be advantageous to the apprentice. All seem to realize the need for training apprentices but does the industry consider the training of supervisors to be essential? The Ministry of Labour and National Service instituted its "Training within Industry" scheme during the last war, in which the supervisor was encouraged to develop three skills, those of instruction, human relations, and improving methods. Many firms now ensure that their supervisors receive this training and much requires to be done and will certainly have to be done, to improve the standard of supervision. This can best be effected by well-thought-out training schemes. The Institute of British Foundrymen has organized Foremen's Training Courses, which have proved most helpful to those attending, but much more is required in this connection if the present progressive outlook among steelfounders is to be maintained. The dissemination of technical information, and works visits, and discussions, can be used to help the training of supervisors.

Good Housekeeping

It is stated frequently that there is a serious shortage of labour in the foundries of this country, and in the Author's view this shortage is likely to persist, —and it will be necessary to improve working conditions if the industry is to retain the existing numbers employed. It can do much to improve the general tidiness and cleanliness of the shops by good-housekeeping methods. A completely new outlook and approach to the problems is required; all parties will have to co-operate to effect the improved conditions. It is known that managements are considering amenities such as washing and changing facilities, but many simple shop-floor improvements can be made without great capital expenditure. The installation of dust-extracted mechanical knock-outs, are very desirable, but if the rest of the shop is not kept clean and tidy, the mechanical aids lose their effectiveness.

Similarly, the maintenance of tackle in an efficient condition, greatly helps in the building up of the spirit or morale of the organization and, in the future, it will be necessary to pay very great attention to that aspect of foundry organization.

Safety-first committees and the services of a safety engineer, will assist in directing the attention of

personnel to the need for good and safe practices and can be the means of educating all parties in better methods. It is a common experience among steelfounders that safety glasses and respirators, etc., frequently fall into disuse, but given a really live safety-first committee, that tendency can be reversed and all can be made aware of the need for the right and full use of safety devices. Again, it is a matter of outlook and one must ensure that the right lead it set.

Foundry Methods

The Author has left the very numerous problems of foundry methods until the end. A great change in the heading and gating methods has taken place during the last few years. The steelfoundry industry is indebted to Mr. Basil Gray for the immense amount of work which he put in the development and application of the whirlgate heading system. Then came the atmospherically-vented enclosed head and, still more recently, the application and use of the knock-off head. Much data and information have been published, but there remains a large amount of work to be done, before it can be claimed that the full potentialities of these methods have been established. Very great assistance can be obtained in the study of the efficiency of feeding-head shapes and systems, by X-ray or gamma-ray examination of the resultant castings, and it is the Author's view that steelfounders cannot afford *not* to have these aids. It is realised that foundrymen have been suspicious of the use of X-rays, etc., but great economies can result from the intelligent application of these non-destructive testing methods, when used to check foundry production methods. It is of great benefit to shop-floor personnel to be able to examine X-ray prints of castings, and it helps them to understand better what changes take place in the cooling of liquid steel down to room temperature, and the volume changes that take place.

It is of great value to any foundry organization to keep detailed methods sketches and histories. In the past, foundrymen have relied upon their memories and this has on occasions led to faults being repeated. The regular analysis of causes for rejection of steel castings provides the foundry methods-engineers with data as to the relative importance of the causes and so enables the most pressing ones to receive first attention. The circulation of this data to the shop-floor personnel is also helpful to them.

It can be stated that greatly-improved yields can be effected by the study and modification of head and runner designs in the light of the X-ray soundness or otherwise of castings, and in the reduction and elimination of wasters. There is a very great field of activity here for the young steelfoundry executive. The industry is indebted to the foundry productivity team for drawing attention to the possibilities inherent in the use of exothermic feeding materials. Improvements in the yield weight of black castings, in relation to their gross casting weight, of as much as 20 per cent. have already been achieved, but here again there is field for further endeavour. Apart from the improvement in yield of castings in terms of weight, it is now established that it is possible to make sounder castings with the use of less steel. The use of knock-off heads results in other economies in the cost of production, apart from any saving in the amount of steel used. The elimination of most of the oxy-acetylene burning and the removal of feeding heads from high-carbon and alloy steel castings prior to annealing, is advantageous and there is also a reduction in the amount of dressing by grinding.

A regular study by the foundry methods-engineers of the quality of castings passing to the fettling shops, will reveal the types of defects and problems demanding attention and rectification, and it is always helpful to have these faults recorded in the casting histories. It is considered that a detailed study of the chilling practice employed in any steel foundry is a well-worth-while project—and very little data or information have yet been published on this subject. The use of special mould- and core-paints (such as chrome paint), for corners and re-entrant angles, is another subject calling for investigation and development, and the Author feels that there will be some very interesting developments in this field.

From time to time, suggestions are made that the industry should try the use of non-silicious moulding materials—and of course it has been established that Norwegian olivine can be successfully used for steel casting production. Chromite has been used for the production of a limited number of types of manganese-steel castings, and no doubt there are many other possible materials. There is here a great field for research and development work—and the Author feels confident that there will be an increasing emphasis put on this problem.

The views expressed in these notes are those held by the Author, and do not necessarily represent those of the Company with which he is connected. He is indebted to the directors of Hadfields Limited, for kind permission to put forward these notes.

Société Française de Métallurgie

The *Société Française de Métallurgie* will hold its *Journées Métallurgiques d'Automne* in Paris from October 20 to 25, inclusive, at the Maison de la Chimie, 28 bis, rue St. Dominique, Parjs, 7e. Two main subjects will be discussed :—(1) Faults and fractures observed in metals during service, and (2) methods of effecting economies in metals in short supply, including the rational use of alloys and the substitution of different varieties or qualities of alloys or methods of fabrication to ensure the best use of scarce elements. A few communications on other subjects will be allowed at some of the sessions. The programme will include communications by metallurgists from many European countries and from the United States. A number of visits, including one to the new laboratories of the *Institut de Recherches de la Sidérurgie*, at Saint-Germain-on-Laye, are being arranged. Other visits and a banquet will be held during the week. British metallurgists will be welcomed and those interested should apply for further details to the *Société Française de Métallurgie*, 25, rue de Clichy, Paris, 9ème.

Institute of British Foundrymen

London branch Annual General Meeting

The annual general meeting and an ordinary meeting of the London branch of the Institution of British Foundrymen was held in the Waldorf Hotel, Aldwych, W.C.2, at the session end, with Mr. L. G. Beresford, the branch president, in the Chair. Commencing with the business meeting, in the absence of the treasurer, the secretary, Mr. W. G. Mochrie, presented the detailed accounts for adoption. The motion was seconded by Mr. A. R. Wizard and carried unanimously. The secretary's annual report was then presented by Mr. W. G. Mochrie, from which the following has been abstracted:—

Secretary's Report

In presenting his third annual report, the secretary first of all briefly listed technical meetings which had taken place during the session. As usual, the winter's work opened in September; on this occasion the new president, Mr. L. G. Beresford, was inducted into office by the immediate past-president, Mr. F. E. Tibbenham. The presidential address will be remembered for, among other things, the hope expressed that this year would be a record in the history of the London branch. There can be little doubt that this has been realized. Following this address there was Mr. Parkes' report on the Ardennes Visit by the London branch, before an audience of about 110. On October 12, the London branch acted as hosts to the rest of the Institute on the occasion of the National Works Visits day, when fourteen works were visited, and the programme completed by an informal dinner and cabaret in the evening. Altogether the number of registrations was 348, which compared favourably with the first of such events held in Birmingham the previous year. From the reports received, members can be sure that the prestige of the London branch was well upheld.

The October meeting comprised Mr. Levy's illustrated Paper on "Some Everyday Practices in Patternmaking," when about 125 members and guests were present. The subject of the November meeting arose from a suggestion at the last annual general meeting and took the form of the airing of "Problems in Recruitment and Apprentices," when the subject was opened by Mr. A. Talbot. Amongst those bodies invited to take part were the Development Panel and directorate of the Council of Ironfoundry Associations, the South of England Ironfounders' Association, West Bromwich Training College, Middlesex County Council Education Committee. the Youth Panel of the Ministry of Labour, the Association of Bronze and Brass Founders, and the National Union of Foundry Workers. It was agreed by those who attended, numbering upwards of 100, that it had been a long time since there had been such a controversial evening.

On December 12 the branch were hosts to the London section of the Institute of Metals. On this occasion Mr. A. P. Fenn, backed by his 40 yrs. experience in the industry, gave his Paper on the "Development of Aluminium Alloy Casting." The attendance was upwards of 150. At the January meeting members were fortunate to have Mr. Lawrie, of H.M. Inspector of Factories (Engineering and Chemical branch), who gave an address and film entitled "The Observation and Control of Dust in Foundry Dressing Operations." This was preceded by introductory remarks on the implementation of the Garrett Report by the national president of the Institute, Mr. Colin Gresty. About 100 members and visitors were present. A symposium on "Investment Casting" took place in February, the proceedings being inaugurated by Mr. G. A. Tomkinson, of D. Napier & Son, Limited, Mr. Frank Hudson (Mond Nickel Company, Limited), Mr. Paget (de Havilland Engine Company), and Mr. Andrews and Mr. Brown, of Lost Wax Castings, Limited. Films illustrated the processes and more than twenty speakers participated in the discussions.

In March the branch were again hosts, this time to the Purchasing Officers' Association, when the "Buyer's Point of View" was ably expounded by Mr. Kayser, past-president of the branch. Mr. Huebner and Mr. Mitchell opened the discussion for the guests and the interesting debate that followed was shared by a large number of the eighty or so present.

The Paper on the present evening, by Mr. R. Pell, on "Surface Finish and Facing Sands," marked the close of the session's technical monthly meetings. Without wishing to pre-judge the merits of this Paper, it was obvious from the attendance that members were looking forward to what Mr. Pell had to say with more than just passing interest.

Sections' Activities

The sections attached to the London branch had again been very busy. The East Anglian section had had seven meetings and the Slough section six. East Anglia reported that their annual dinner and concert was resumed during the session, when fifty members attended. Average attendance at their technical sessions continued to be excellent, averaging approximately 33 per cent. of all their possible members. They have to be complimented on the fact that, with the exception of one meeting, all the technical lectures had been presented by local members. The secretaries of the sections, Mr. Hoesli at Slough and Mr. Sanders in East Anglia, were to be particularly praised for such a successful year's work. To meet the wishes of members in the Southampton area, where Dr. Einerl had been particularly active, the London branch were

I.B.F. London branch Annual General Meeting

proposing to arrange meetings in Southampton. It was proposed that, subject to attendances and response generally being up to a required level a section would be formed in that area.

Social Events

The branch social events this year had been arranged by Mr. Parkes, the dinner/dance taking place a little earlier than normal and being very well attended, in fact a record was created in the number of tickets sold (259). The occasion marked the official visit of the national president and his lady to the branch function. The "Stag Party" in the spring had proved so popular that quite a number of requests had to be turned down as accommodation could not be found for them; actual attendance was 174.

The last official meeting of the branch would be in Paris at the end of June. Circulars had already been sent out concerning this interesting trip, and additional circulars would be sent only to those members expressing desire to attend.

The branch was honoured in being given the opportunity to reciprocate the hospitality of founders in the French Ardennes on the occasion of their visit to London early in May. An interesting five-day programme had been arranged (again by Mr. Parkes). The secretary personally hoped that this interchange of Continental visits would become a regular feature of the branch's syllabus.

Although there would be the usual annual lull of technical meetings during the summer months, the branch council would still be active continuing the work they had been doing throughout the session. There had been seven Council meetings and four sub-committee meetings.

The work of the branch council, under the leadership of the president, had been reflected first of all in the variety of Papers and events that had taken place during the session; secondly, by the large attendance at these meetings; and thirdly, with members' co-operation, in the record number on the membership roll.

Membership

There was always a discrepancy between the figure given at the annual general meeting and the final figure appearing in the Annual Report of the Institute at the June conference, and although this latter figure would probably read about 784 members, composed of 30 subscribing firms, 398 members, 286 associate members and 70 associates, the actual total in the branch register, subject to approval of a batch of applications sent up to Council today is just over 800. It is most probable that the London branch is now the largest qualified body of foundrymen in the world—a record of which members might be justly proud. Adding just one further word more on membership, the secretary said the strength of the branch was largely dependent on members for the introduction of new blood, a vital prerequisite to its health. During the past session, upwards of 72 new applications had been received. Each application required two sponsors and the list below was an analysis of the way in which introductions were made in the branch over the period:—

1	member sponsored	12	new applications.
2	members ,,	10	,, ,, each.
4	,, ,,	5	,, ,, ,,
4	,, ,,	4	,, ,, ,,
8	,, ,,	2	,, ,, ,,
60	,, ,,	1	,, ,, ,,
79		72	new forms.

A total of 79 different members acting as sponsors and—for the statistician—18 members *only* accounted for half the total new applications. Did this do justice to a membership roll of 800? For fun, he would perhaps one day make a list of names that had never appeared as a sponsor!

The secretary concluded his report by thanking the members of the branch council, past-presidents, stewards and many other willing helpers who had assisted in countless ways in running the branch affairs.

Mr. Bissett then proposed the adoption of the secretary's report and Mr. B. Levy seconded, emphasizing the fact that the work of running the branch had proved so onerous that Mr. Mochrie had found it necessary to call on the services of Mr. Parkes to assist him in the duties and together they had done a Trojan job of work. When put to the vote, the report was carried unanimously.

On behalf of Mr. Hudson, Mr. Mochrie next presented a report of the work of the Technical Council. [This was mainly a record of branch participation in what has appeared as the main report of the Institute's Technical Council and is therefore not reproduced in this context.]

Before proceeding with the election of officers the chairman mentioned that a short time ago one of the oldest members of the branch, Mr. Cleaver, had died. He had been hon. auditor of the branch for 20 years and was well known to the older members. On behalf of the branch, the secretary had attended the funeral and a wreath was sent. The members stood in silence for a few moments in honour of the memory of Mr. Cleaver.

Office Bearers

The following gentlemen were elected as office bearers in the branch for the session 1952-1953:—As *president*, Mr. D. Graham Bissett; as *senior vice-president*, Mr. B. Levy; as *junior vice-president*, Mr. W. Wilson; as *honorary secretary*, Mr. W. G. Mochrie; as *honorary auditors*, Mr. V. Delport and Mr. Barrington Hooper; as *representative on the Technical Council*, Mr. F. Hudson; as *members of branch Council*, Mr. M. Glenny (re-elected) and Mr. A. Talbot, and as *branch representatives to the Institute's general Council*, Mr. E. M. Currie, Mr. C. Kain and Mr. F. Arnold Wilson. Finally, the *stewards*, Mr. E. Harwood Brown, Mr. G. C. Pierce, Mr. R. Pipes, Mr. A. Whiles and Mr. A. R. Wizard were re-elected as was the *honorary projectionist*, Mr. J. P. Ellis.

The rest of the evening was devoted to hearing Mr. Roy Pell lecturing on the subject of "Surface Finish and Facing Sands," which Paper will be printed in a subsequent issue of the JOURNAL.

Cores instead of Loose Pieces

By F. H. Wakeham

The casting of a brake pulley shown in the sectional drawing, Fig. 1, may be made almost entirely by the use of cores. This type of casting recommends itself to quantity-production moulding. The use of three cores dispenses with the necessity for a three-part mould, and with any loose-pieces on the pattern. The pattern is built up in segments in preference to a solid job, since there is not the same tendency for the timber to shrink. The core-prints are built with the pattern as the work proceeds.

Coreboxes

Corebox "A" Fig. 1, is a full corebox and is turned in segments, the flange being built and turned separately and dowelled into position in the main corebox. The recess to accommodate the centre boss is turned before the first course of segments is built on. It will be noted that by recessing the plate for the centre boss and the first course of segments, " feather-edges " are avoided at the fillets. The centre boss may be secured by screws from the bottom of the corebox or allowed to remain loose. The print for the centre core is turned in one piece with the boss. Corebox " B " (Fig. 1 (c)), is similar in construction to A; the sides of its interior portion being tapered to correspond to the taper on the core-prints of the pattern. Such taper should be generous so that the pattern and corebox strip easily and cleanly; it also prevents the possibility of the core crushing the core-seating when setting in the mould. The central portion, which forms the outside of the casting, is positioned by means of a turned wooden spigot. The centre corebox (Fig. 1 (d)) is a full corebox, dowelled, and made in halves; the print at the large end being of the same diameter as the centre boss. The large area of the core-print ensures the accurate positioning and centering of the core. This core is easily gummed into the print in core A, and the two cores then united can be set into place in the mould.

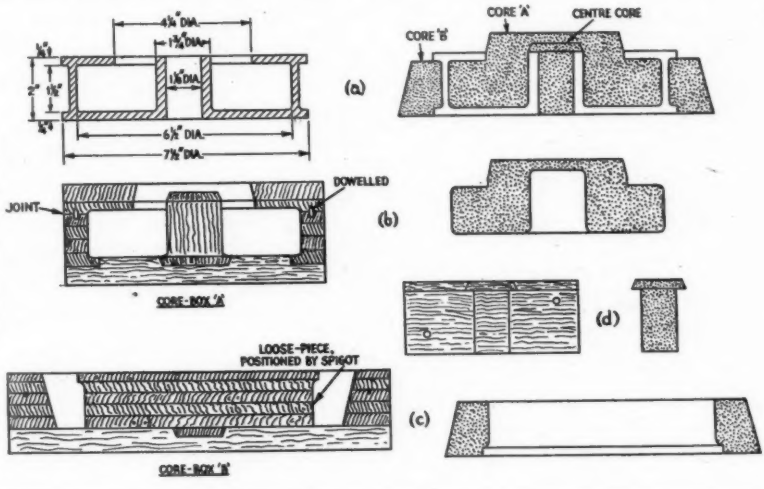


FIG. 1. — *Sections through a Brake-pulley Casting to be machined all over, as well as Coreboxes and Cores used in its Production; (a) Casting and Core Assembly, (b) Corebox and Core, A, (c) Corebox and Core, B, (d) Corebox and Core, C.*

New Foundry School Opened

Mr. William Rennie, chairman of Federated Founders, Limited, formally opened on June 3 the new foundry school for apprentices which has been established at Burnbank, Falkirk, by Stirling County Education Committee. The school has been in session since May 19, and the attendance has been most gratifying. Since then, between 50 and 55 students have been present each day, and it is the hope of the Education Committee that this attendance will be maintained. Employers in the light-castings industry donated £5,000 towards the purchase of Burnbank Foundry for the establishment of the school as a centre of technical education for the industry. In the centre itself, provision is being made for courses of instruction on a day-release basis, for moulding, patternmaking, fitting and sheet-metal work. Students will, of course, receive instruction in English and science and social studies relating to the light-castings industry. Students are expected to attend the training centre for a period of three years or until they reach the age of 18.

So far, the Education Committee have appointed the following staff—headmaster and instructors in English and social studies, patternmaking and technical drawing, science and calculations, moulding and fitting. The necessary equipment has also been installed at the centre. Students will be able to have a mid-day meal in the dining room which has been provided. There was a large attendance at the opening ceremony which was presided over by Mr. A. K. Davidson, J.P., Bannockburn, chairman of the Education Committee.

Direct-reading Spectrograph

Our representative recently visited the London Colney works of John Dale, Limited, primarily to inspect a new installation—the first of its type in this country of a direct-reading spectrograph employed in the analysis of aluminium alloys. The apparatus has been installed by Mr. F. C. Mathieu, manager of the Compagnie Radio-Cinéma of Paris, and is now working very satisfactorally. The instrument is very flexible, and consists of three parts, the generator for producing the light source, the spectrograph and the measuring device—including selecting, receiving, amplifying and recording—which is electronic. It is this final section which is new and of present interest and importance.

The light source is by Dürr and the circuit, which is of the Feussner type with a control gap, produces a condensed spark and has a choice of capacitance and inductance. The spectrograph is the "Nouvelle-Zélande" by Jobin et Yvon and is a medium quartz with a spectrum range in the ultra-violet from 2,300 to 4,500A in 200 mm. The samples are cast in flat plates about 1 cm. thick, the ends are faced with a fly cutter and they are sparked against counter electrodes of graphite.

Instead of the usual photographic plate a reading head is installed at the end of the spectrograph and houses two caesium-antimony photocells of the electron multiplier type, one of which is so lined up as to receive the ultra-violet radiation from the standard line, in this case aluminium at wavelength 3,962A, and the other travels along the focal plane receiving in turn the radiations from the sample at selected wavelengths for other elements being determined. It is made possible to do this by two rulers, one, the master ruler which contains a very accurately placed stop for all the wavelengths it may be required to use, and the other, the programme ruler, which contains a notch at the position of each wavelength selected to be used on the particular alloy being analysed. This ruler allows the travelling photocell to slow down just before reaching the wavelength and to be quite free from vibration when the recording is being made. The photocell moves automatically into the next notch to record the next element and at the end returns automatically to the starting point. The degree of amplification for each wavelength is also selected by this ruler.

The current set up in the photocell is multiplied to the order of 10^7 and passes to a pre-amplifier valve also in the head and then through a three-stage amplifier. Finally, the output from the two cells is matched by a ratio potentiometer and a pen recorder registers this value. These ratios found for standard samples are correlated with very accurately determined figures from the chemical laboratory and standard graphs produced, from which the analysis of an unknown sample can be made during the time of recording.

The whole analysis for seven elements, nickel, titanium, copper, silicon, magnesium, iron and manganese can be completed in 2½ minutes and for ten elements, *i.e.*, with zinc, tin and lead, which necessitates the use of another ruler in about 4 minutes. For routine analysis, the whole process is completely automatic from one push button including the spark, timing, recording at each wavelength and the return of the movable photocell to the starting position for the next sample. This is of great importance in maintaining standard conditions with different operators.

The flexibility of the instrument lies in the fact that it can also be used manually for searching for other lines or elements not included on the rulers, or to examine the behaviour of any one element at a variety of electrical conditions for development work. It is also possible, when needed, to convert to photographic work in less than a minute. The change from one alloy to another is made in a few seconds by changing only the programme ruler and electrical settings. The accuracy of the method is that of the usual spectrographic methods, about ± 4 per cent. of the amount present, but as there is no photographic plate with its attendant variations, the analysis by direct reading is in many cases, especially where the percentage content is less than 2·0, much better than this.

The great advantage over all other methods of metallurgical analysis is the speed. By use of the direct-reading spectrograph a sample can be completely analysed whilst the metal is kept molten in the furnace, thus allowing for the necessary additions, if any, to be made before pouring or casting is begun. In this way, production of scrap material is prevented and labour and fuel is saved on re-melting and re-casting. Analytical control in the foundry thus becomes a workable factor. Again, in case of trouble, a quick check analysis can be made and so confirm one factor immediately. From a routine point of view large quantities of ingot material can be analysed in a minimum time. In addition, trace and impurity elements which are often laborious, difficult and inaccurate by wet methods, can be done with equal speed, *e.g.*, zinc, tin and lead in aluminium. This helps in two ways, first by confirming the presence or absence of small traces, qualifies the material, and secondly, does not delay the despatch of material whilst these are being determined after the major alloying elements are completed. The instrument is making possible a new standard of foundry control which must result in improvement, not only in quality of material, but in economy of labour and times of delivery.

Die-casting Foundry

The London Colney works include two departments of interest to our readers. One is an aluminium die-casting foundry, making aircraft and automobile components and the second an aluminium alloy ingot factory, the output of which is sold to foundries against specification, for remelting and casting into engineering components.

INDUSTRIAL ACTIVITY IN JAPAN trebled itself between 1946 and 1951, by which year the overall index figure was 147.4, the figure of 100 representing average industrial production during the years 1932-36. The only branch of industrial capacity which failed to exceed the 1932-36 level was the textile industry, which is still at not much more than half its pre-war level.

THE JAMAICAN BAUXITE INDUSTRY is going ahead with schemes that will involve a capital expenditure of over £22,300,000, mostly from Canada and the U.S.A., with substantial assistance provided through E.C.A. and sterling counterpart funds. Two of the companies engaged in the industry will export the ore after it has been dried and one of them, the largest of the three, made its first shipment last month for processing in North America. The third company will partly process the ore in Jamaica and ship the powdered alumina.

I.B.F. Buxton Proceedings

Following a brief interval after the annual general meeting of the Institute of British Foundrymen on June 11, at the Buxton Conference, which has already been reported in the JOURNAL, members reassembled to hear the presidential address. Before delivering this address, the president, Dr. C. J. Dadswell, called on the secretary to read two telegrams from Mr. R. B. Templeton. In the first he regretted his inability to attend the conference and wished the meeting success. The other, personally to the president wished him a successful year of office.

The presidential address, entitled "A Sense of Proportion,"* was then delivered.

Vote of Thanks

MR. COLIN GRESTY, proposing a vote of thanks to the president for his address, said it was obviously a matter to which the president had given much thought. He had mentioned the foundry foreman's course and he could say from his own experience that, like the president, he had found that course very stimulating and often provocative. Dr. Dadswell had carried the matter further and shown the tremendous value in provoking thought and having discussions from that important section of the membership of the Institute which had to conduct operations, namely the foremen. Those discussions had always been very forthright and he personally in his own experience had not found any meeting so stimulating and thought-provoking. It was, therefore, most interesting to him, to have heard Dr. Dadswell's further reflections on that very important subject. He proposed a very hearty vote of thanks to the president for his address.

MR. JOHN BAILES, who seconded, said that that morning many speakers had embarked on reminiscences, but the president had asked them to look forward, and he thought that was the type of leadership they were to receive from the president. Looking forward, what could they do to improve conditions; to improve productivity; to improve themselves? Their president was one of the men who was going to show them the way, and he had great pleasure in seconding the motion.

DR. DADSWELL replying, said the writing of an address was no easy matter when so many eminent predecessors had with skill ranged over wide fields of interest in previous years. It was during Mr. Gresty's presidential address last year that he had first started wondering on what subject he could address members on this present occasion. The subject then chosen, had been long ago discarded, as had also several alternatives. Having subsequently prepared the present address he had qualms as to it being rather too controversial for such an event, but he hoped it might have been of some use and given food for thought.

* Printed in the JOURNAL, June 12.

Edward Williams Lecture

Following the presidential address the Edward Williams Lecture was given.

Calling on the lecturer, Professor R. J. Sarjant, Professor of Fuel Technology, University of Sheffield to deliver this, the president said the title of the lecture, "Fuel and Metal,"* seemed to him very fascinating because without fuel there would be no metal. Professor Sarjant was an example of what all university professors should be; he had not always been in academic life; he had worked in industry and he had been associated not only with steelworks, but also with foundries.

MR. J. J. SHEEHAN (past-president) said he had the honour of proposing a vote of thanks, and he said "honour" deliberately because he also was a Royal College of Science man, knowing that the old College of Science was originally the College of Mines. Through their lecturer, they had had brought home to them the ability of scientists to get from the earth the refractories, the metals and the fuels.

He complimented the lecturer on the accuracy with which he had finished the timing of a long lecture and on the presentation of a great many facts. He had known Professor Sarjant for a very long time and had always felt that he had an outstanding capacity for collecting a multiplicity of facts and presenting them accurately. He was the reverse of the strong silent men they read about in novels. As a rule they were silent because they had nothing to talk about. He thought members would all be looking forward to reading the lecture in print and he was very pleased formally to propose a vote of thanks to their lecturer.

Hope for the Future

MR. COLIN KAIN, seconding, said fuel figured very prominently in the lives of all, both domestically and industrially. Domestically it was very largely one of supply, and industrially it was largely a question of quality and he thanked Professor Sarjant for giving founders some hope for the future and encouragement that they could look forward to the results of the work now being done in Sheffield to procure better foundry coke.

Replying, PROFESSOR SARJANT said he was delighted to see members from the old College, and he greatly appreciated their reception of his lecture. He had some doubts in putting it across for he knew that practical foundrymen like themselves would not want a lot of "long-haired nonsense." They would want to talk of practical work, but he had come to the conclusion that if the "long-haired stuff" was properly done, while having one's feet properly on the ground, ultimately they were going to produce something of value to practical men. He felt highly honoured and much appreciated the fact that he had been invited to give that lecture.

Pig-iron and Steel Production

Statistical Summary of March Returns

The following particulars of pig-iron and steel produced in Great Britain have been extracted from the Statistical Bulletin for April, 1952, issued by the British Iron and Steel Federation. Table I summaries activities during the previous six months. Table II gives production of steel ingots and castings in March, and Table III, deliveries of finished steel. Table IV gives the production of pig-iron and ferro-alloys in March and number of furnaces in blast. All figures in thousands of tons.

TABLE I.—*General Summary of Pig-iron and Steel Production.*

Period	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy). Imports.[1]	Output of ingots and castings.	Deliveries of finished steel.	Stocks.[2]
1950	249	174	197	185	197	9	313	241	997
1951	282	170	206	186	175	8	301	243	589
1951—October	278	180	210	190	174	11	301	245	595
November	280	192	215	196	182	13	316	253	568
December	278	189	216	198	159	10	288	234	589
1952—January	293	190	222	199	164	13	293	243	540
February	302	187	222	197	177	20	313	236	525
March	303	184	221	202	181	23	320	252	551

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in March*, 1952.

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex ..	—	3.6	11.4 (basic)	1.9	0.1	16.0	1.0	17.0
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	1.7	20.8	—	1.9	0.6	23.7	1.3	25.0
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	31.4	—	—	0.1	31.4	0.1	31.5
North-East Coast	1.8	60.1	—	1.2	0.5	61.6	2.0	63.6
Scotland	4.0	35.1	—	1.6	0.9	39.4	2.2	41.6
Staffs., Shrops., Worcs. and Warwick	—	16.2	—	0.9	0.9	16.3	1.7	18.0
S. Wales and Monmouthshire	8.1	57.4	5.4 (basic)	1.2	0.1	71.6	0.6	72.2
Sheffield (incl. small quantity in Manchester) ..	9.2	24.7	—	9.4	0.7	41.7	2.3	44.0
North-West Coast	0.1	2.0	4.7 (acid)	0.4	0.1	7.1	0.2	7.3
Total	24.9	251.3	21.5	18.5	4.0	308.8	11.4	320.2
February, 1952	25.4	244.5	21.2	18.0	4.0	302.0	11.1	313.1
March, 1951	26.2	253.0	20.6	15.2	3.2	309.4	8.8	318.2

TABLE III.—*Weekly Average Deliveries of Finished Steel.*

Product.	1950.	1951.	1951. March.	1952. Feb.	1952. March.
Non-alloy steel :					
Ingots, blooms, billets and slabs[3]	3.6	4.0	4.0	4.5	4.7
Heavy rails, sleepers, etc.	11.3	10.1	11.4	9.3	11.2
Plates ⅛ in. thick and over ..	40.0	41.0	43.9	41.0	42.1
Other heavy prod.	40.2	39.9	42.6	38.5	39.5
Light rolled prod.	47.6	47.1	52.3	44.2	44.9
Hot-rolled strip ..	19.4	19.5	21.1	18.7	18.4
Wire rods	16.3	16.1	17.5	15.4	16.2
Cold-rolled strip ..	5.5	6.0	5.6	6.0	6.3
Bright steel bars ..	6.3	6.6	7.0	5.7	6.4
Sheets, coated and uncoated ..	30.5	33.5	31.3	36.3	40.1
Tin, terne, blackplate	14.3	13.9	16.0	16.3	16.6
Tubes, pipes and fittings	20.0	22.0	21.7	21.6	23.9
Mild wire	12.5	11.9	12.8	12.3	12.9
Hard wire ..	3.5	3.7	4.1	3.4	3.8
Tyres, wheel, axles	3.5	3.7	3.0	1.9	3.4
Steel forgings (excl. drop forgings) ..	2.2	2.3	2.3	2.6	2.9
Steel castings ..	3.5	3.8	3.5	4.1	4.1
Tool and magnet steel	[6]	[6]	[6]	0.4	0.5
Total	280.2	285.1	300.1	282.2	297.9
Alloy steel	10.6	12.3	12.4	13.1	14.8
Total deliveries from U.K. prod.[4] ..	290.8	297.4	312.5	295.3	312.7
Add : Imported finished steel ..	3.8	4.9	3.7	11.5	12.2
	294.6	302.3	316.2	306.8	324.9
Deduct : Intra-industry conversion[5] ..	55.6	61.5	62.3	72.4	74.9
Total net deliveries ..	241.0	242.8	255.9	236.4	252.0

TABLE IV.—*Weekly Average Production of Pig-iron and Ferro-alloys during March*, 1952.

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	25	—	19.6	23.4	1.0	—	44.0
Lancs. (excl. N.W. Coast), Denbigh, Flints and Cheshire	6	—	8.2	—	—	0.7	8.9
Yorkshire (incl. Sheffield, excl. N.E. Coast) ..							
Lincolnshire ..	13	—	28.3	—	—	—	28.3
North-East Coast	24	5.2	41.4	0.4	—	0.8	47.8
Scotland	9	0.8	13.1	3.5	—	—	17.4
Staffs., Shrops., Worcs., and Warwick ..	9	—	9.1	1.5	—	—	10.6
S. Wales and Monmouthshire	8	2.8	24.1	—	—	—	26.9
North-West Coast	8	16.6	—	0.2	—	1.0	17.8
Total ..	102	25.4	143.8	29.0	1.0	2.5	201.7
February, 1952 ..	100	27.9	135.2	29.4	1.8	3.1	197.4
March, 1951 ..	99	25.9	127.0	26.2	1.3	3.7	184.1

[1] Weekly average of calendar month.

[2] Stocks at the end of the years and months shown.

[3] Other than for conversion into any form of finished steel listed above.

[4] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

[5] *i.e.*, Material for conversion into other products also listed above.

[6] Included with alloy steel.

Ford Motor's New Coke Ovens

Sir Rowland Smith, chairman of the Ford Motor Company, Limited, recently lit the first of the new battery of 48 coke ovens which will replace the old coke-oven plant first put into operation at Ford Works, Dagenham, 18 years ago. The new ovens are of the latest under-fired design capable of being heated by rich coke-oven gas or lean blast-furnace gas, and are a distinct advance in design, giving greater operating economies and control facilities. The nature of the site made it necessary for the whole structure to rest on piles—765 in all. The piles were precast—14 in. square with an average length of 35 ft. The oven raft serves as a capping raft for the piles and is designed as a whole, monolithic with the pinion end and oven superstructure. The finished basement raft provides the working floor for operating the mechanism under the ovens—ample headroom being allowed.

The types of refractory brick chosen for the ovens include silica, silica quartzite and anti-acid bricks, to give successively reducing expansion coefficients where the changes of temperature are widest and most frequent during operation, so as to minimize movement due to expansion and contraction. To prevent dragging of lower expanding materials situated below higher expanding brickwork and to prevent the formation of cracks, the battery is provided with the Coppée patent steel rod-and-band system for controlling expansion, whereby large diameter rods are placed at each point where the composition of the bricks changes. The fuel-gas distribution system is of the underfired type with accurate control of gas quantity to each separate vertical flue by means of specially designed cocks, which can be accurately and quickly set and changed at will. Header pipes carry the gas at any controlled, pre-determined pressure, so that a change of supply through one riser pipe does not affect the supply through adjacent riser pipes.

Self-sealing doors are provided on both the pusher and coke sides of the battery, and the main cast-iron door framing has detachable sections for holding the firebrick lining. The doors on the pusher side are provided with leveller doors of an improved design. In order to cut down the loss of gas when charging the ovens and at the same time have a cleaner atmosphere and working conditions for the operators, double collector mains—one each side of the battery—are provided with a connecting cross-over main coupled up to the existing suction main. The new chimney is 250 ft. high, which is 15 ft. higher than the older one, this being necessary because the air for combustion is obtained by natural draught instead of being supplied under pressure by fan. In the construction of these new ovens, including chimney, a total of 1,231,400 bricks of 506 various shapes has been laid.

WEAVERS at the Dunfermline works of Erskine Beveridge & Company, Limited, textile manufacturers, are being employed to break up hundreds of old looms in the factory for scrap.

ALLIED IRONFOUNDERS Social & Sports Club, Angling Section, travelled by special bus last week to Loch Lyon to compete in the fourth "leg" for the Hill Cup. Heavy rain continued all night; 31 members competed. Prize-winners were: 1st, P. Buchanan, Callendar Works, 9 lb. 14 oz.; 2nd, G. Craig, Callendar Works, 4 lb. and 3rd, J. Young, Falkirk Iron Works, 3 lb. 15 oz. The Hill Cup Competition was won by Mr. J. Corbett, Callendar Abbots with 3 lb. 14 oz.

Scottish Lead and Zinc Mines May Reopen

The directors of Bangrin Tin Dredging Company, Limited, and Siamese Tin Syndicate, Limited, subject to the concurrence of shareholders, have put forward a proposition which may ultimately lead to the reopening of the lead and zinc mines at Leadhills and Wanlockhead (Scotland). An option is held on these properties, and preliminary investigations, together with technical advice tendered to the boards of both Companies, have encouraged them to put forward proposals for a plan of action. *Inter alia*, this provides for de-watering the modern Glencrieff section of Wanlockhead Mine to enable major sampling to be undertaken, and the installation of a small pilot mill, while exploratory and sampling operations would also be extended to the Leadhills section. If adequate ore reserves are eventually revealed, the aim would be the erection and putting to work of a full-scale mill of a capacity of not less than 400 tons per 24 hours.

Shareholders have been provided with technical reports from Mr. J. A'C. Bergne, a director of both undertakings, and by two mining engineers, Mr. J. B. Richardson and Dr. R. A. Mackay, and general agreement is reached that capital expenditure up to production will involve £200,000 for development work, while the capital cost of the mill and acquisition of mineral rights would not exceed £250,000. Assuming an average grade ore of 5 per cent. lead giving an 80 per cent. concentrate at 90 per cent. recovery, together with the revenue from zinc, Mr. Hunter put the gross working profit at £79,750, before tax, with lead at £100 a ton, on the milling of 400 tons per day, but an improvement in grade of 1 per cent. lead would bring an increase in revenue of £76,250, while an 8 per cent. ore would yield a gross profit of £340,000. Mr. K. O. Hunter is chairman of both undertakings, while Dr. Mackay is the consulting geologist to the Companies.

British Standards Institution

Sizes of X-ray Film and Intensifying Screens (*B.S.* 1443: 1952)

The British Standards Institution has recently issued a revised edition of British Standard 1443, "Sizes of X-ray film and intensifying screens." This standard relates to such material for medical and industrial use, other than dental X-ray films and X-ray films for crystallography, for which separate British Standards will be issued in due course.

In preparing this new edition, a careful review has been made of the schedule of nominal sizes, and it has been found desirable to include two additional sizes, namely 11 by 14 in. and 15 by 40 cm. Minor adjustments have been made in respect of the tolerances on the cutting sizes of the films, and where the nominal sizes are the same as those for photographic sheet film, as specified in B.S. 1772, the cutting dimensions and tolerances have now been brought completely into accord in these two standards.

Reference to the internal dimensions of cassettes has been omitted, as it is intended to prepare a separate British Standard for the dimensions of cassettes. The method of marking packaged films and screens is indicated. Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 24, Victoria Street, London, S.W.1., price 2/-.

Personal

MR. A. KENNETH CLYDE has been appointed assistant chief engineer of Tiltman Langley Laboratories, Limited, research and development engineers, of Redhill (Surrey).

MR. E. RAWES, secretary of Birlec, Limited, has been presented with a gold watch to commemorate the completion of his 40 yrs.' service in the International Nickel organization.

MR. R. A. SMITH, managing and governing director of Lowdon Bros. & Company (Engineers), Limited, Dundee, has been appointed president of the Electrical Contractors' Association of Scotland for the ensuing year.

IT WAS ANNOUNCED at the annual meeting of Harland & Wolff, Limited, Belfast, that MR. ATHOLL BLAIR is to retire from the board of directors, although he will continue to serve in a consultative capacity. Mr. Blair has been with the company for nearly 50 years, starting as a student in 1903.

MR. GEORGE F. I. CLIXBY, who is very well known throughout the industry, recently completed 50 years' service with Appleby & Company, Ironfounders, a company associated with the Renishaw Iron Company, Limited. At a recent meeting of directors he was presented with an inscribed gold watch and a cheque.

MR. E. HUNTER, technical director of the foundry engineering division of the Incandescent Heat Company, Limited, Smethwick, has been elected president of the Birmingham, Coventry and West Midlands branch of the Institute of British Foundrymen. Mr. Hunter is a fellow of the Institution of Metallurgists and a member of the executive council of the Midland Ironfounders' Association.

THE MINISTER OF SUPPLY announces that MR. KENNETH GORDON, C.B.E., M.C., has been appointed Director-General of Ordnance Factories and will take up his post on July 1. Mr. Gordon, who is 55, has been specially released for this purpose by Head, Wrightson & Company, Limited, who only last November appointed him deputy managing director of Head Wrightson Processes, Limited.

MR. J. AYRES, general manager of Petters, Limited, Staines, has been appointed managing director of that Company. He became general manager of Petters in July, 1951; formerly he had been works director of the Brush Electrical Engineering Company, Limited, Loughborough. He joined the Brush ABOE Group in 1946. MR. A. E. CARRODUS has been appointed to the Board of Petters, Limited, as sales director.

NEWLY-ELECTED honorary members of the Institution of Mechanical Engineers are LORD DUDLEY GORDON and MR. JAMES ALEXANDER JAMESON. The honour was conferred on Lord Dudley Gordon for his distinguished services to the institution and to the achievement of its objects, and on Mr. Jameson for distinction in the practice, organization, and administration of engineering. Lord Dudley Gordon is chairman both of J. & E. Hall, Limited, Dartford (Kent), and of Hadfields, Limited, Sheffield, and a director of other companies. Mr. Jameson is a director of the Anglo-Iranian Oil Company, Limited. He served his engineering apprenticeship with D. & W. Henderson & Company, Limited, shiprepairers, of Glasgow.

DR. D. V. ATTERTON is joining Foundry Services, Limited, in July to fill the newly-established post of research and development manager. Dr. Atterton has been at Cambridge University for the past eight years, and received the Ph.D. degree in 1950 for a thesis on the penetration of molten metal into compacted sand and on the surface tension and contact angle of molten tin with silica. For the past two years he has been engaged on further fundamental research on foundry problems sponsored by the Research and Development Division of the British Steel Founders' Association. It will be remembered that he presented, as the outcome of this work, a Paper "Thermal Expansion and Contraction of Compacted Sand" at the recent conference of the Institute of British Foundrymen.

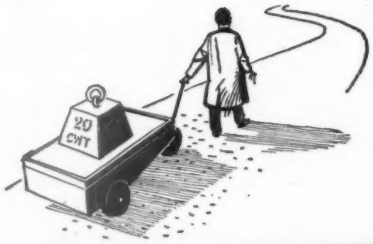
SIR GUY ROPNER, who is a director of the Consett Iron Company, Limited, has been elected deputy chairman and chairman of the sub-committees of classification of Lloyd's Register of Shipping. MR. R. M. TURNBULL, who is a director of the Mercantile Dry Dock Company, Limited, has been elected vice-chairman of the sub-committees of classification. MR. J. HODGSON, who has been appointed chief ship surveyor, in succession to MR. R. B. SHEPHEARD, who is leaving to take up an important position with the Shipbuilding Conference, served his apprenticeship with Irvine's Ship Building & Dry Dock Company (1930), Limited, Hartlepool. He was afterwards employed by Sir W. G. Armstrong Whitworth & Company, Limited, on the ship designing staff, and was appointed a ship surveyor to Lloyd's Register in 1919.

MR. T. H. SUMMERSON has just been appointed chairman of the home affairs and transport division and an honorary vice-president of the Association of British Chambers of Commerce. He is chairman and joint managing director of a group of heavy industrial companies under Thomas Summerson & Sons, Limited, and Summerson's Foundries, Limited, Darlington, which were originally established by one of his forebears in 1840. He is a past-president and still a very active member of the Tees-side and South West Durham Chamber of Commerce, and has just completed three years as chairman of the Darlington Rural District Council. Serving also as chairman of the Darlington County magistrates and a member of the Aycliffe New Town Development Corporation, he recently assumed the responsibilities of chairmanship of the British Steel Founders' Association. During the last war he was Director for Steel Castings in the Iron and Steel Control of the Ministry of Supply. Mr. Sumerson succeeds MR. HARRY YATES as chairman of the home affairs division. Mr. Yates is now president of the Association.

Damages for Crane Slinger

Damages of £1,000 were awarded on June 5 to William Elliott, crane slinger, of Gallowhill Road, Paisley, against his employers, Fullerton, Hodgart & Barclay, Limited, engineers, of Paisley. On May 14, 1950, Elliott, who is 65, was lifting a metal casting with the assistance of an engineer. The engineer slipped and Elliott had to bear the whole weight until the engineer recovered his position. As a result of the sudden strain he sustained injuries to the lower part of his back and both thighs. A few days later he had to give up work. He could not walk comfortably and still required a stick to assist him.

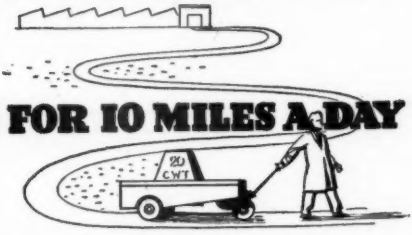
The pursuer, who claimed £1,500, blamed the Company for failing to provide a safe system of working. For the defendants it was contended that they had fulfilled all their duties. The accident was wholly fortuitous, it was stated, or it was the fault of the pursuer, who took insufficient, if any, precautions for his own safety. The jury, which sat with Lord Birnam, was unanimous.



UP HILLS

ROUND CORNERS

BACKING INTO AWKWARD SPOTS



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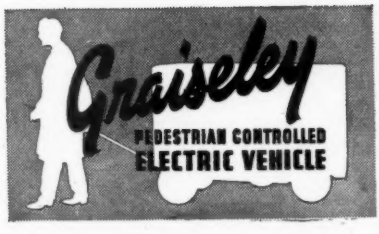

DIAMOND MOTORS (WOLVERHAMPTON) LTD., UPPER VILLIERS STREET, WOLVERHAMPTON. Tel. 22951

News in Brief

TWENTY I.C.I. pensioners made a visit to the Company's mechanized works at Tunstead on June 18. They were welcomed by the production director, Mr. F. C. Covill.

IT IS ANNOUNCED that when the all-steel coaches for sleeping cars are put in production, a portion of them will be built at the Derby workshops of the British Railways.

ON THE ANNUAL WORKS OUTING of Taylor Bros. (Sandiacre), Limited, Sandiacre, 470 employees and their wives were the guests of the firm on a trip to Blackpool.

LORD HIVES opened the proceedings at the third children's and employees' sports day of the Hucknall Division of Rolls-Royce, Limited, held on June 14, on the Hucknall aerodrome.

THIRTY-SEVEN EMPLOYEES of Petters, Limited, branch at Burton-on-the-Wolds, with 20 or more years' service with the firm, or with the Brush group, have been presented with appropriate gifts.

FOR THE TRAINING of Pakistani students in a branch of mechanical engineering at Loughborough College, the Burmah-Shell Oil Company has established two annual scholarships, worth £450 a year.

ACHESON COLLOIDS, LIMITED, of Plymouth, have a club for those who have served the Company for 25 years. At its last London Chapter meeting, Mr. H. Higinbotham was elected president and Mr. G. H. Turner the secretary.

ESTIMATED to be worth about £500,000, an order for 100 doubledeck buses has been placed by the Midland "Red" Omnibus Company, which normally operates vehicles of its own design and manufacture, with Leyland Motors, Limited. The bodies will employ the standard Leyland metal-framed structure.

KEITH BLACKMAN LIMITED announce that during their summer holidays their works will be closed as follows: Arbroath Works, from 5.30 p.m. July 18 to 7.45 a.m. August 4; Tottenham Works, from 5.45 p.m. August 8, to 8 a.m. August 25. No goods will be despatched from the works during the period they are closed but goods inwards will be accepted.

THAT THERE HAS BEEN an improvement in the supply of steel sufficient to enable all firms in West Bromwich, with one exception, to resume full-time working was stated by Mr. J. K. Fergusson, secretary of the West Bromwich Local Employment Committee in his quarterly report on June 18. He pointed out that there is still difficulty in securing labour for the ironfoundry industry.

THE PERMANENT-MAGNET DEPARTMENT of Edgar Allen & Company, Limited, will exhibit on stand No. 230 at the International Machine Tool Exhibition a wide range of magnets of various types, and in addition will present a panel in which representative magnets for scientific instruments, electricity meters, electric clock mechanisms, etc., will be grouped and linked up with illustrations of the actual products in which these magnets are incorporated.

AT A MEETING of Meltham Urban Council, a petition from residents in the area was read complaining that they were being kept awake at night because of the noise from the nearby David Brown tractor works. It was stated that tractors drawing trailers containing loose castings were descending Knowle Lane at 15-min. intervals during the night, and it was suggested that sufficient castings should be delivered in the day-time to meet the requirements of the night shift. On a motion by Mr. H. Hirst, the Council decided to send a letter to the Company asking for an abatement of the night-time noises.

VISITORS FROM SWITZERLAND, SARAWAK AND TANGANYIKA attended the meeting of the Wolverhampton and District Industrial Accident Prevention group at the West Bromwich works of George Salter & Company, Limited, on June 12, when a wireless set was presented to Mr. A. J. Mercer in recognition of his work as secretary to the group from its foundation in 1946 until 1951. The presentation was made by Mr. B. A. Inshaw, director of the Industrial Safety Division of the R.S.P.A. Mr. Inshaw stressed the need for complete understanding on the question of industrial safety between employees and employers.

TO CONVINCE the public of the rapid modernization of even the heaviest of industries, Joseph Sankey & Sons, Limited, last Saturday opened its new extension at Manor Works, Ettingshall, Wolverhampton, to relatives and friends of the employees. Nearly 1,000 visitors were entertained at the "open day" which took the place of an official opening ceremony. The total floor space of the new building is 145,000 sq. ft., including a large gallery which accommodates works, offices, canteen, and washing and locker rooms. The new mill is exceptionally light and airy. An underground air duct provides ventilation in the hot finishing mill.

TO HELP Midland workers understand the principles of the technical processes on which they are employed, the Department of Science and Industry of Birmingham City Museum and Art Gallery is to produce a series of leaflets written for the layman, which will be sold for a few pence at the recently established Museum of Science and Industry in Newhall Street. The suggestion comes from Mr. N. W. Bertenshaw, keeper of the Department. The first publication is "Boulton, Watt and the Soho Undertakings," a pocket-size brochure with illustrations intended to supplement the display in the museum. In addition to the leaflets, it is planned to issue further brochures of this kind.

A PUSH-BUTTON-OPERATED planing machine, weighing 220 tons, specially built for J. G. Kincaid's works at Greenock, started off from Tyneside on Saturday last in 25 parts, a lorry to each part. The £40,000 machine, 60 ft. long and 25 ft. high, is the biggest, most modern of its kind in Britain. The makers—Noble & Lund, of Felling, Newcastle—say it planes 30 ft. engine bedplates to an extremely high accuracy, all by push-button. Kincaid's have been laying foundations for the machine for two months. They want it for heavy work on new Diesel engines. Work on a second machine, for David Rowan & Company, Limited, Glasgow, is to start immediately and is expected to be completed by the end of the year. A third machine for Clydeside is then planned.

FOLLOWING A STATEMENT made by a spokesman of Rolls-Royce, Limited, at a meeting of manufacturers in Barnoldswick to the effect that the firm could not consider further expansion unless housing accommodation was made available, Barnoldswick Urban Council is to give urgent consideration to the question of building more houses. It was stated also that the firm was losing skilled men to other firms because of the lack of houses in the vicinity of their Barnoldswick works. Many of the firm's employees were having to travel to Barnoldswick from Keighley, Skipton, Silsden and also from towns in East Lancashire. The Council will give special attention to the possible speeding up of work on the housing site at Coates between Barnoldswick and Skipton.

Matching the machine and the need

HOLMAN LEADERSHIP IN PNEUMATIC TOOL DEVELOPMENT

Unremitting research and experiment have enabled Holman Bros. to develop numerous fresh and effective applications of compressed-air power to the needs of industry. Pneumatic Tools made in Camborne can be seen at work in many of the world's best-known motor-car factories, railway works, shipyards, oil refineries and public works enterprises. In nearly every branch of industry, new needs have brought new and improved Holman Pneumatic Tools.

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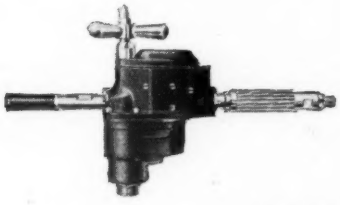

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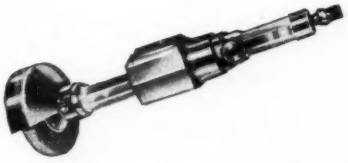
New Series—with interchangeable motors. Simply constructed, robust and free from vibration. Automatic lubrication. Reversing mechanism gives equal power in either direction, and a stalled drill can be restarted at once.



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SUBSIDIARY COMPANIES, BRANCHES AND AGENCIES THROUGHOUT THE WORLD HC20

Raw Material Markets

Iron and Steel

Although there was a slight decrease in pig-iron production last month as compared with April, outputs are being maintained near the 10,500,000-ton mark and there are prospects of further expansion. Steelmakers are benefiting by the larger tonnages which the furnaces are able to send forward, as evidenced by the increased output of steel in May. The large blast furnace blown in at the Skinningrove Works recently will add a further 3,500 to 5,000 tons per week of basic pig-iron for steel production. With the other new furnace previously blown in on the north-east coast, the extra supplies of pig-iron will ease considerably the raw material position for the steelworks in that area.

The steelworks have to rely to a large extent on pig-iron as the amount of scrap available is much below requirements. Home sources are being searched for supplies, and while good results have been achieved, the limiting factor is the dearth in deliveries from oversea.

The foundries also are incommoded proportionately by the scrap shortage, particularly heavy machinery and cast-iron scrap, and they have to be content with parcels of lighter material which arise. The shortage of suitable scrap compels them to use larger quantities of pig-iron in their mixtures.

The improved outputs of pig-iron are not benefiting the foundries to the same extent as the steelworks, and their supply position shows little, if any, improvement on the hand-to-mouth existence under which they have been working for some time. The low- and medium-phosphoric irons are not produced in the quantities called for by the engineering and speciality foundries. Hematite remains very scarce. Supplies of high phosphoric pig-iron barely meet the needs of the light and jobbing foundries.

Foundry coke is coming forward regularly, but quantities are small and barely cover consumption. In fact, some foundries are receiving insufficient coke to meet their current needs. This confirms the statement made by the Minister of Fuel and Power that present deliveries of coke to ironfoundries fall below consumption requirements to the extent of between 5 and 10 per cent.

Ganister, limestone, and firebricks are available in sufficient quantities to cover requirements, and those foundries in need of ferro-alloys are able to obtain supplies to meet their needs.

There is little, if any, improvement in the supply of semi-finished steel to the re-rollers. Deliveries from abroad are not yet sufficient to relieve the position. There is no hope of an improvement in outputs until this is accomplished, as home steelworks find it impossible to increase allocations. Deliveries of small sections, bars, and strip are badly in arrears, much of it being required for priority work. The sheet re-rollers are also heavily engaged and continue to press for more raw material, but supplies are scarce.

Non-ferrous Metals

At the end of last week the Ministry of Materials made its promised statement on the pricing situation in copper and explained how the new figure of £281 was arrived at. The explanation was given in some detail, including the build-up of the revised selling limit which is based on an agreed figure of 33 cents (£264). To this is added £12 (previously £11) to cover freight, insurance, delivery charges, etc., and an item of £5 representing the Ministry's losses suffered in supplying this market at £231 for something like a fortnight after the "Engineering and Mining Journal" quotation had risen above 27½ cents.

It is evident that the fullest co-operation was afforded by the producers in arriving at the revised level of 33 cents., which is firm until June 30. The July basis is to receive consideration in due course, and much must inevitably depend on the course of values in New York during the ensuing days. The hope is expressed that the market will quieten down and achieve stability at a reasonable level. But doubtless opinions will differ widely on what constitutes a proper level for copper.

As we write, the indications are rather that a figure around 35 cents is being more freely paid in the States, this, of course, being for Chilean metal. It has been reported that Lord Swinton intends to set up a Working Party to consider under what conditions, doubtless including safeguards, a free market could be re-established in copper. In this connection the Government's recent decision about lead will be fresh in every mind.

Zinc had fallen again in the United States and the new level of 15 cents (£120) made it necessary for the Ministry of Materials to reduce its selling price to U.K. consumers by £8 to £130 a ton. Zinc has now declined by £60 from the peak quotation in this country of £190.

An Order, made by the Minister of Supply, came into force on Monday, freeing secondary zinc, zinc alloys, zinc scrap, and gunmetal scrap from price control. The Order also adjusted the prices of secondary copper, brass, copper scrap, gilding metal scrap, brass scrap, and cupro-nickel scrap to take account of the recent changes in the selling price of the Ministry of Materials of virgin zinc and copper.

Two increases, each of £4, have been made this week in the lead price, bringing the current quotation to £137 a ton.

Trading in tin last week was not very brisk and the price trend rather downwards. On Friday last the quotations fell rather sharply in the afternoon, and on balance cash was £11 lower on the week while three months lost £6.

London Metal Exchange official tin quotations were as follow:—

Cash—Thursday, £968 10s. to £969; Friday, £964 to £966; Monday, £963 to £965; Tuesday, £970 to £971; Wednesday, £970 to £970 10s.

Three Months—Thursday, £966 to £966 10s.; Friday, £962 to £964; Monday, £961 to £962; Tuesday, £968 to £969; Wednesday, £967 10s. to £968.

Export of Aluminium Manufactures

The Board of Trade has announced that from July 1 the price per ton below which it restricts exports of general manufactures of aluminium will be increased from £180 per ton to £220 per ton. These arrangements, first introduced in July, 1950, restrict exports of aluminium goods of a low "conversion value," and the present increase takes account of higher aluminium prices.

This change has been effected by the cancellation of the existing open general licence and the issue of a new one for goods over the value of £220 per ton.

THE MINISTRY OF MATERIALS has announced that from June 25, 1952, its buying price for rough copper in slabs of from 2 to 3 cwt. is raised from £180 to £230 per ton.

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Established 1902

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Five Decades of Progress

When Bessemer, in 1861, invented the pneumatic method, he created a veritable revolution in the steel industry. Nothing of a similar character has occurred during the last fifty years in foundry practice. What developments there have been were evolutionary. Thus it is truthful to state that in 1902 there were some foundries—as for example the one operated by Alfred Herbert—which were in every respect more modern than some in existence to-day. Yet evolution has brought about many striking changes. Many of these of course are common to industry in general. Typical of these are the shorter working week, the growth of mass-production methods, and improved amenities to include heating, lighting, ventilation and the provision of washing, bathing and catering facilities.

Special to the foundry industry—and, by the way, we claim to have changed the designation from "trade" to "industry"—is that this era has produced a consciousness of the outstanding benefits to be achieved through co-operative action. For those enlightened individuals who worked so strenuously to bring about these conditions, it has indeed been a hard fight, as the firms manufacturing castings range from concerns classifiable as 100 per cent. "foundry" to others where the output of cast products is negligible in relation to their total business. Starting from zero, there has been built up, especially in the last decade, a complete network of employers' associations. Now, they are an essential feature in the business structure of this country, as Government planning, whilst ameliorating one situation, creates difficulties for the various manufacturing industries.

Technically, the outstanding feature has been control, which has provided the engineering industry with a much wider range of alloys of enhanced mechanical and physical properties. Obviously, technical control has needed the spur of research, but we preferred to cite "control" because the results of research are of but academic interest until they come to be embraced within this activity. If, fifty years ago, there existed any classes for teaching foundry technology, their number was certainly attenuated. Nowadays, facilities exist either nationally or locally covering all requirements from the neophyte moulder to the skilled technician.

International technical co-operation has been developed in a unique fashion, well-worthy of emulation by other industries. Since 1922, there has been without interruption an exchange of papers between our industry and the American and, since 1926, there have been organized—annually, under normal conditions—more than a dozen conferences in ten different countries.

The industry to-day is in good shape. Though there is a shortage of man-power and raw materials, and a virtual ban on the acquisition of new buildings and modern plant, there is amongst foundry owners and executives an attitude of mind reflecting an enthusiasm for productivity and its attainment. The heterogeneous character of the output of the foundry industry represents ideal conditions for technical co-operation because for every competitor there are some three or four thousand other manufacturers of castings capable of giving useful help without detriment to their own commercial activities. By utilizing to the full these conditions during the forthcoming years, the prospects for our industry are indeed bright.

The Editor: Mr. V. C. Faulkner

Mr. Faulkner was born in December, 1888, and was educated at Wesley College and in the metallurgical department of Sheffield University. His first appointment was as chemist to the firm of Hobson Houghtons Limited and later he held a similar position in the laboratories of Vickers Sons and Maxim. About 1911, he joined the late Mr. Victor Stobie, then trading as the Sheffield Annealing Works Company, to assist in the development of the first Electro-Metals furnace to be installed in this country. With him was Mr. R. A. MacGregor, C.S.I., and real pioneer work was carried out. About 1913, Mr. Stobie removed the works to Dunston-on-Tyne, where he traded as the Stobie Steel Company. Here better progress was made, using a 3- and a 10-ton furnace. The next appointment was as steel foundry manager to the National Steam Car Company, situated at Chelmsford. Then in 1916 he joined Electro-Metals Limited and was soon sent to Bilbao in Spain to put into operation the first electric furnace ever to be installed in that country. The plant was an undoubted success and, next, he installed a plant at the Le Creusot Works, of Schneider et Cie. This was followed by a trip to Milan, where a plant was installed in the works of Commendatore Vanzetti. Other plant installations were carried out at Decazeville in the South of France and at Bellegarde on the French side of the Swiss frontier (though this was after he had left Electro-Metals and joined the Greaves Etchells concern).

Towards the end of 1920, Mr. Faulkner was appointed Editor of the FOUNDRY TRADE JOURNAL, *his first task being to change the publication from monthly to weekly. He straightaway became active in the Institute of British Foundrymen (which he had joined in 1908) and, in 1921, was elected honorary secretary of the London branch. By 1923, he was elected London branch president and in 1926, national president of the Institute. About this time he founded the Foundry Equipment and Supplies Association and was its first president. This involved the occupying of a similar position in connection with a foundry exhibition. In the following year, he participated in the founding of the International Committee of the Foundry Technical Associations. It was that year also that he was co-opted to the Council of the British Cast Iron Research Association and served continuously until after the '39-45 war. In 1934, he was co-opted to the committee of the National Ironfounding Employers Federation, when it was engaged on the study of the possibility of a pig-iron levy. In 1934, also, he was awarded the Oliver Stubbs Medal, whilst the next year he was elected a vice-president of the Institute of Vitreous Enamellers, of which body he was also a founder member. In that year, too, he was active as the chairman of the Sheffield University Advisory Committee on a Degree Course in foundry practice. In 1946, he was awarded honorary membership of the Czecho-Slovak Foundrymen's Association and in 1948 became president of the International Committee of Foundry Technical Associations. The last honour he received and the one he values most highly was the award of honorary membership of the Institute of British Foundrymen which was conferred at the Cheltenham Conference in 1949. In 1949, he was admitted into the Livery of the Worshipful Company of Founders. Mr. Faulkner, who is a Fellow of the Royal Society of Arts, holds membership in the Iron and Steel Institute, the Institute of Metals, the Institute of Welding, the American Foundrymen's Society, the Institute of Australian Foundrymen, and the* Association Technique de Fonderie.

50 YEARS

From the Editor's Viewpoint

By V. C. FAULKNER, F.R.S.A.

From unique knowledge of the foundry industry, accorded by his tenure of the editorial chair for the last 30 years, Mr. Faulkner surveys the industry as portrayed in the pages of the JOURNAL, *using a viewpoint tempered by experience which only such long years of service could give. Like a true spectator, he has seen most of the game, is able dispassionately to assess upheavals and measure results with unbiased judgment. Beginning with the industry as it was, each decade is reviewed in turn and the account enlivened by a wealth of pertinent comment. He leaves only the future a blank—doubtless for posterity to write—for in all things the business of the* JOURNAL *is to record and not invent.*

The Victorian period had just reached its glorious conclusion when some person now unknown launched the FOUNDRY TRADE JOURNAL. From the first issue, just 50 years ago, it would appear that the Editor then had no clear notion that the foundry trade was quite different from the iron and steel industry, as he publishes a quotation from the daily Press stating that the late Mr. Charles Schwab was of opinion that the latter, so far as this country was concerned, was rapidly dying out. The Edwardian period was characterized by the gradual replacement of horse transport by the petrol engine and this had a profound influence on the foundry industry, for the making of cylinder castings by hand, using ordinary clay-bonded cores was extremely difficult. The generally accepted story for the solving of the impasse is that the late Mr. Morewood—a founder member of the British Foundrymen's Association—when foundry manager at Willans' foundry at Thames Ditton brought from Belgium a recipe for the making of oil-sand cores, and developed this when his firm removed as Willans & Robinson to Rugby.

Status Quo

The foundry industry of fifty years ago, was, with a few notable exceptions, carried on in ill-lit shops, with only hand-worked cranes as aids to production. Yet much machinery was available, and a mechanized foundry was installed in America. The light-alloy foundry was virtually non-existent, whilst the steel foundries were producing aggregations of steel and sand which after much fettling took some sort of shape. Ironfounding on the other hand was well established. It had made its contribution to the full development of the railway systems of the country, which, with the possible exception of the main line to Marylebone, were then complete. There was, of course, no real motor-car industry, whilst aeroplanes were only flying in dreamland. For local traffic, the horse reigned supreme, and no foundry of any consequence was complete without its accompanying stables. This formed a cheap supply of material for mixing with the sand for opening the texture. In those days sand was sand, not even silica grains and clay—that was to come later as the JOURNAL disseminated technology.

The usual working week was 60 hours, but "*la semaine anglaise*" (5½-day week) was firmly established in this country, although by no means universally. The population then, as now, crowded the football stands every Saturday afternoon. Very cheap excursion fares permitted the "fans" to follow their teams to away matches, or to indulge in a week-end's fishing—a very popular pastime with foundry workers.

The young scientist in the foundry was unknown, and control was limited to the foot-rule, the eyes, the touch, and the sound resulting from a hammer blow, plus an occasional transverse test on a cast bar. Yet some excellent castings were made, the best of a routine nature being the locomotive and other engine-cylinder castings. The melting plant used was of a simple character, invariably being solid-bottom cupolas or crucibles. The raw materials were much as to-day, but, with few exceptions, their quality was excellent. All pig-iron was sand-cast and sold by "numbers." Its constituents were but vaguely known to the few and ignored by the majority. Yet who could blame them! There was no technical Press, no technical institute serving their interests and no place in the proceedings of the learned societies beyond a handful of papers presented to the Institution of Mechanical Engineers on cupola developments.

The First Ten Years (1902-1911)

The changes brought about through the publication of the FOUNDRY TRADE JOURNAL were truly remarkable. Within two years of its establishment, the British Foundrymen's Association was founded. This body is, so far as can be established, the oldest organization in the foundry industry, with the exception of the trade unions. It was not until during the next decade that the National Ironfounding Employers' Federation came into being, though local associations no doubt existed. The urge for the creation of the British Foundrymen's Association came about through mainly anonymous

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letters to the JOURNAL, but at this late date, it can be disclosed that amongst the writers were the late Mr. James Ellis and the late Dr. Percy Longmuir. A handful of enthusiasts turned up at the Old Cock Inn in Birmingham (now the Imperial Hotel), and led by Mr. Finch as honorary secretary, it was decided to go ahead with the Association. All have now passed away, the last survivor being Mr. Robert Mason who later established a steel foundry in Adelaide. He died some three years ago. Three of the founders, Mr. Buchanan, Mr. Cook and Mr. Ellis, later presided over the Association. The initial policy of the new body was the establishment of branches. The FOUNDRY TRADE JOURNAL, by now the property of Eagland & Company, the direct antecedents of its present proprietors, became the official organ of the Association, an honour as much appreciated to-day as it was then.

This peaceful decade (1902 to 1911) was characterized by the onslaught made by the German foundry plant manufacturers to introduce their machines into the British foundry industry. Though during this period, technology was beginning to reach the foundries, the leaders of foundry opinion at that time, with one notable exception (the late Mr. Shaw of Brightside Foundry), held the view that there was no need for these new-fangled machines in their foundries. They were perhaps useful on the Continent, where British craftsmanship could not possibly be emulated. This statement is important as it flatly contradicts the oft-told story that whilst industrialists filled their machine-shops with new plant they were loathe to spend a farthing on the foundry. From an examination of the literature of the period, it was the foundrymen themselves who were to blame for the lack of mechanical progress.

Technology Inaugurated

Metallurgical progress in the ironfoundry was both advanced and retarded by much good advice and an equal quantity of " ballyhoo " emanating from the pig-iron merchants. Yet, on balance, they did much good, as they at least familiarized foundrymen with the application of Professor Turner's pioneer work on the influence of silicon on cast iron. Buchanan was amongst the most enlightened foundrymen of this period, entering into the category of men who helped to propagate the new technology. A misconception about this period which needs correcting is that the Association (which in the future will be called the Institute, though this change of name did not occur until 1921) was more practical in the early days than later on. Recalling the names of the early lecturers makes it plain that theoretical notions were to the fore. Longmuir, Carpenter, Stead, Turner, Hatfield, and Swindon, had personalities not normally associated with the more practical aspects of foundry operations. The writer's personal connection with the Institute dates back to 1908, when he participated in an annual conference held in Birmingham, under the presidency of Mr. F. J. Cook, its third president. From that time, he has enjoyed the personal friendship of every president, except Mr. Mayer of Scotland, who, unfortunately, he never met.

During this period, the average foundryman learnt a little about sand, and became aware that moulding sand was an intimate mixture of silica grains with a clay bond, the " fat " sands carrying a higher percentage of clay than the " lean " ones. Steel foundries were now beginning to make substantial progress, as a number of firms had had prolonged experience with the baby Bessemer. In 1906, the Stock converter came into existence, but the era closed before the electric furnace was put into production. Some primitive induction furnaces were tried out about 1908, but there is no record of their being used in steel foundries. Towards the end of this decade, rumours of war were beginning to make themselves heard, and the concerns making castings for the Admiralty were fully employed. There does not seem to be much news of non-ferrous foundry developments at home during this decade, but foreign innovations were duly recorded.

1912 to 1921—The Impact of the Aeroplane

During most of the period 1912 to 1921, the JOURNAL was edited by Mr. Alexander Hayes, who happily is still a member of the journalistic profession and active as a publicity consultant. For a period, he also acted as honorary secretary of the Institute. However, in 1920-21, the editorial side was looked after by Dr. J. E. Hurst, whilst for the change-over from a monthly to a weekly publication at the end of 1921, the present writer was appointed to the editorial chair—a position he has held ever since.

The 1914-18 war caused great changes in the foundry industry. Quite large contracts were given out to the iron foundries for Mills bombs, practice shells, and other items of armament. There was a real urge to improve the strength of cast iron, and much gossip about " semi-steel." The name was apparently created by Mr. David McLain, an American foundryman, who had more foresight than is usually credited to him. His system did enable foundrymen to add quite a few tons per square inch to the strength of their irons, and, moreover, the castings were of closer grain. These steel-mix irons were the genesis of the high-duty irons which were quickly to follow. Unlike during the second world war, the slogan during the first was " business as usual," and founders found the " going good," as they had both civilian orders and armaments upon which to draw. Thus, not all the war-profits were from the direct making of munitions.

Steelfounders' Busy Period

During this period, the steelfounders were overwhelmed with work, and a number of new concerns came into being, of which not a few disappeared with the post-war slump. One interesting concern which was created was that of Kryn & Lahy at Letchworth Garden City. It came into being to find employment for the many highly-skilled moulders amongst the Belgian refugees. There is scarcely a trace of its Belgian origin left to-day, except that the initials K & L are still retained in the now flourishing firm of " K & L Steelfounders & Engineers, Limited."

The war period saw a remarkable development in the use of electrode electric furnaces. In 1914, there were but four such furnaces in the country, and only one was engaged on steel castings. That was at Lake and Elliot, Limited, of Braintree. By armistice day, the number had grown to over 100, quite a high proportion being installed in steel foundries. Very soon after the war, British and German progress in this field was compared, and it was felt that better progress had been made at home. By the time the war finished, electric steel was being made with an expenditure of about 850 to 900 units per ton; roof life was of the order of 120 heats and the electrode consumption 10 lb. per ton. This was really excellent progress, for the prototype furnaces were equipped with square-section electrodes of which only about a third was usable. The steelfounders, after some attempts by the malleable iron makers, got the worry of producing tank track-links. In general, they were more successful than the makers of the pins used for their assemblies. Apart from the use of electricity as a medium for steel making, there was a continuous expansion in its use for driving cranes and items of plant.

Also during this war period, light alloys became properly established, and large quantities of castings were made for the newly-born aircraft industry. When the war finished there was a phenomenal number of aeroplanes in stock. The brass and bronze foundries were pre-eminent in the whole world for the supply of manganese-bronze propellers, which, at that time, were made by loam moulding—a system since changed. These firms also contributed much to the world's railway developments, and British lighting sets were popular in most countries. The war period saw the birth in France of the Durville process for the rational casting of non-ferrous metals. It was found to be especially useful in the manufacture of aluminium-bronze.

Foundry plant installed during this decade was predominantly foreign in origin and, generally speaking, unintelligently applied. Though moulds were made faster, the foundry executives had not generally the nous to service them properly. Foundry employers' associations were represented by the National Ironfoundry Employers' Federation (formed in 1912) and the National Light Castings Association.

1922 to 1931—Steady Progress

Though marred by the general strike in 1926, and some bad periods of unemployment, 1922 to 1931 was a decade of real progress. It saw the formation of the British Cast Iron Research Association, and the Foundry Equipment and Supplies Association, the inauguration of foundry exhibitions, and international foundry congresses. The first real international gathering was in 1923, when quite a large party of Americans, headed by Dr. G. H. Clamer, the president of the American Foundrymen's Association, made a tour of this country, and then in company with a large British delegation went over to Paris to participate in a foundry congress. Friendships were then made which have since been thoroughly cemented.

Melting Developments

Ever since the invention of the cupola, the scrap returned for remelting carried an increasing content of sulphur, owing to repeated contact with coke By the end of the first world war, the sulphur pick-up had reached dangerous proportions, and "inverse chill" became a universal nuisance. Metallurgically, it was explained by the late Mr. W. H. Poole and others, but it was left to the scientific staff of Imperial Chemical Industries, Limited, to pioneer the soda-ash process for its removal. Especially were Colbeck and Evans prominent in this development.

The British Cast Iron Association did little or nothing for the first five years of its existence. Then Dr. J. G. Pearce was made director and good progress was made, despite the fact the Author once designated him a "scientific Lazarus," for the Association was lamentably short of money until comparatively recent times. Its first major development in the early 'thirties was the introduction of the balanced-blast cupola, which was installed all over the world. There was a second development which was somewhat similar, and which also met with success, namely the Poumay cupola.

During the decade under review, the cupola encountered some competition from rotary, pulverized-fuel-fired, furnaces of which there were two main types—the Sesci and the Brackelsburg. Their development was rapid and extensive, and despite a law case there were, after a few years, no fewer than 130 installations. Probably this figure includes a number of oil-fired Stein & Atkinson, and other types of rotary furnaces. The writer well remembers a visit in 1932 to the Mons foundry where the first Sesci furnace engaged on the production of steel was inspected and reviewed. To this ever-interesting range of rotary furnaces, a basic lining still needs to be developed and perhaps also lining *in situ* instead of using a spare body, the size of which is limited by handling difficulties.

Special Casting Techniques

Another process of permanent value developed during this period was the Holley permanent-mould method for making iron castings in metal dies. Later, it changed its name to the "Eaton-Erb" process, and now it is thought to be known as just the "Eaton" process.

Naturally enough, during this very progressive decade, both the cupola and the new furnaces were shown to be capable of producing high-duty irons, yet in 1928, the first British standard (B.S.I. 321) was issued, demanding but 9 tons per sq. in. for the lowest grade of cast iron, and 11 for the highest, taking the 1.2-in. bar for comparison purposes. This quality was just too easy under the new conditions, and almost before it was in general use, there was a strong feeling that the standard would be replaced by something more realistic.

As a sort of appendix to foundry developments, progress was registered in the field of the surface-finishing of castings. Dr. Hurst pioneered the nitrogen hardening of cast iron. Then there came into being the Institute of Vitreous Enamellers,

which from its inception reversed the centuries-old custom of secrecy in this art into one of open discussion, with material advantages to a small, progressive, and compact secondary industry.

This era saw the development of the centrifugal casting process, with which Dr. Hurst and Mr. T. R. Twigger were prominently identified for the smaller components, and Mr. E. J. Fox and Mr. P. H. Wilson for the production of large-diameter cast-iron pipes by the de Lavaud process. The latter was indeed a hard fight, and only after "teasing" an extra grant from the Board of the Stanton Ironworks Company, Limited, was success achieved. This outstanding British development has since spread all over the world. This was followed by the pioneering of the sand-spun process by the American Cast Iron Pipe Company of Birmingham, Alabama, with which the name of Dr. James Mackenzie is prominently identified. He visited Europe in connection with the installation of new plants.

In 1924, pioneer work was done by the International Nickel Company on the influence of nickel in cast iron, and it is interesting to note that at that time the alloy was more correctly designated "Nickeliferous cast iron." It is supposed that current fashion for using nouns as adjectives is the disease responsible!

The Sandslinger became a feature in British foundry practice during this decade. It could have been better applied initially if only users had had the "savvy" to accord it decent servicing. It is only recently, apparently, that there has been a realization that to obtain a proper benefit from new plant installations, thought must be given to transporting material and auxiliary components to and from the production machines.

Pearlitic Iron

In 1922, the Lanz concern was visited to ascertain the progress made in the production of pearlitic cast iron by the hot-mould process. Undoubtedly, good pearlitic cast iron was being made, but control was virtually non-existent; yet a second visit a few years later disclosed that this state of affairs had been remedied. On the earlier occasion, a plant for the cleaning of castings by a high-pressure water system was also inspected. It was neither a commercial nor a technical success until, during the 1939-45 war, the Americans developed the combination of sand with the water blast. It seems useful to interpolate here as a matter of history that the gossip at that time credited the first practical experiments with water-jet cleaning to the late Mr. Charles Markham of the Staveley Iron & Coal Company many years earlier. It was about the time of the introduction of oil-sand cores, and realizing the efficiency of the new development, Mr. Markham promptly abandoned his water-cleaning system.

To continue with the story of pearlitic cast iron, its significance should not be overlooked, as it was amongst the first steps towards a better understanding of the metallurgy of cast iron, and was the immediate forerunner of the high-duty irons. Its introduction resulted in much discussion, some bordering on the acrimonious, but kept within the bounds of decency in the JOURNAL by a strict Editorial pen. A second development of this period was the invention of non-magnetic cast iron by the late Mr. Dawson of Ferranti's. The creator of this noteworthy development has never received the *kudos* that he so well merited. It was during this period too that the Simpson mixer was introduced into British foundry practice. Also during this period, Smalley's article on the influence of elements on cast iron appeared, which was for two decades a constant source of reference by the world's metallurgists.

The year 1926 stands out in the writer's memory, as it was this year that he presided over the Institute of British Foundrymen, the Foundry Equipment and Supplies' Association, and a foundry exhibition held in the Agricultural Hall. It was also the year of the general strike. 1926 saw also the appointment of Mr. T. Makemson as the first whole-time secretary of the Institute. There was a foundrymen's banquet at the Cecil Hotel, where for the first time ladies were invited, and the creation (actually in January, 1927) of the International Committee of the Foundry Technical Associations. The exhibition was not a great success—possibly owing to the strike—but there was a German exhibit which created great interest, and that was one incorporating a moulding system using a stream of sand from a flexible pipe. This was not really successful, but the idea was taken up by the late Mr. Victor Stobie during this last war, and was known as the Sandontap process. That too met with some technical, but not commercial, success, the inventor dying before his machine came to fruition.

The Institute's Presidents

The third decade opened with Mr. Oliver Stubbs as president of the Institute. He was a really outstanding character, and a true leader. For items on the agenda, he had a method of getting his own way, either by adhering to the rules of the Institute or by insisting that the main object of a council meeting was to interpret or even change the rules. It was Mr. Stubbs who originated the system of an annual exchange paper with the American Foundrymen's Association, which practice has continued without a break from 1922. He was lavish in his hospitality, and won for himself well-deserved popularity. Next came Mr. Bob Patterson of Newcastle, a man who managed to retain real youth until his retirement. He produced one of the most intelligent presidential addresses ever presented to the Institute. He was somewhat shy, but possessed much charm. A third notable president was the late Mr. Wesley Lambert, C.B.E., in 1929. He was one of the very few non-ferrous metallurgists ever to occupy the chair of the Institute. His whole career was devoted to making businessmen and workmen appreciate the scope of science in manufacture of castings and he presided over the first real international congress ever to be held in this country. He was followed by the late Mr. Andrew Harley, the first representative of the motor-car castings foundry to occupy the chair. He was a

Scot who exuded practical foundrywork in all his public utterances, coupled with excerpts from Burns. This decade closed with the chair being occupied by the late Mr. Victor Stobie, M.I.E.E., a very charming electrical and metallurgical engineer, whose connection with the foundry industry was somewhat remote. He was an inventor of no mean order, and the range of his activities covered electric melting furnaces, the cinema, and a moulding system.

International Co-operation

In the Spring of 1927, British foundrymen joined a large party from Europe and sailed for New York on the Lancastria. Mr. John Cameron headed the British delegation, and such was the comradeship evinced that thereafter until the war broke out in 1939, there were regular meetings of the "Club Lancastria," which were organized by the late Mr. Frank Russell. Other international conferences were held in London, Prague, Spain (where the British delegation consisted of Dr. Everest, Mr. Makemson, and the writer) and elsewhere.

1932 to 1941 Period

If the decade 1932 to 1941 can be designated as a rather drab period in history, it was certainly not so for the foundry industry. It was an era where the mechanization of castings production extended from the automobile foundry to many other sections. The JOURNAL faithfully recorded almost all of the new plants as they came into being. They were not all successful, and several were demolished, some foundries reverting to hand-moulding methods. Sometimes this was due to faulty positioning and other times to rank bad management.

Metallurgically, there were great advances in the production of special irons. During this period, inoculation of cast iron became established, and with it the development of the Meehanite process. The valuable damping capacity of castings became known and appreciated by engineers. Austenitic and acicular iron came into production, whilst Ni-resist, Ni-tensyl, Silal, and other irons became popular. These alloy irons are already contaminating the world's scrap pile with elements which when controlled are valuable, but uncontrolled can be a real nuisance.

The makers of builders' castings began to replace the traditional methods of manufacture by mechanization, a development which was to be greatly accelerated during the following decade. They gave much support to the Institute of Vitreous Enamellers, a body which was very active in the immediate pre-war period. Amongst other activities it organized a visit to the States, where, on arrival, exclusive use of air travel served to economize time.

There were many changes in methods of production. Synthetic sand incorporating bentonite or other special clays became increasingly popular. The Randupson cement-moulding process was introduced, and has retained a permanent place in British foundry practice, especially for the making of steel castings and manganese-bronze propellers. When the war brought about shortages, prepared Fuller's earth, carrying the trade name of Fulbond, proved itself to be so successful that it too is still popular as a binding agent for moulding sand.

Training and Equipment

The training of foundrymen was now given serious attention and the British Foundry School in the conduct of which Dr. Pearce took such a personal interest, laid the foundations of advanced instruction for the youth of the Industry. A second innovation was the inauguration of a degree course in foundry practice at Sheffield University. The interest aroused initially by this development waned with the passing of time. It is possible that the academic mind does not view with favour the award of degrees carrying an industrial significance between brackets.

In the field of foundry equipment there came into use the airless abrasive shot-blasting machine, the magnetic moulding machine, one of the few pieces of foundry plant which is 100 per cent. British in origin and design, and, towards the very end of the decade, the Hydroblast. It was also during this period that the high-frequency induction furnace became established as a melting medium in the steel foundries. The light-alloy foundry industry witnessed steady progress with die-casting taking more and more business from the sand foundry. The magnesium-alloy section received great impetus from the rearmament programme. The larger foundry concerns installed important research laboratories; X-ray examinations and the use of spectroscopic analysis became matters of routine. Welding changed from an incidental skill into an industry of national importance, but, despite early prophesies, made no serious competition with cast products. Plastics, too, were developing, but here instead of competition, this new industry became a really good customer of the foundry for presses and dies.

War

When war broke out, controls were set up for all sections of the industry, and as Government departments required "somebody to talk to," there was a recrudescence of interest in employers' associations. For many years two major organizations, the British Ironfounders' Association and the National Ironfounding Employers' Federation, had been well established. The former served the makers of builders' castings, and the latter catered for a wide range of jobbing foundries—but not all. Thus there came into being the Ironfounders' National Confederation. Yet, when the concentration of the ironfoundry industry was mooted, Mr. FitzHerbert Wright very energetically tackled the problem by the creation of the Council of Ironfoundry Associations. This body had no individual members, but only representatives from the various foundry organizations. It was an immediate success, and it was able to limit "concentration" to the Metropolitan area. From that time onwards, the ironfoundry industry has been in possession of an authoritative body to represent its views. With the outbreak of war, the ironfoundry industry learnt that there was little place in armaments for cast iron. There was gossip that in the highest military circles an old retired army staff officer turned down cast-

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iron armaments because of a failure in his greenhouse boiler! However, as the war intensified, certain sections of the industry, such as those making petrol-driven engines, became increasingly busy.

Institute Progress

Until the outbreak of war, this period was outstanding in the field of international foundry cooperation. Meetings were held in the United States, Paris, Italy, Prague, Poland and, in 1939, in London. Because of the impending crisis, American participation was meagre, but the continental countries were strongly represented. The banquet—and there were meals worthy of that name even as late as 1939—was probably the largest ever to be held in European foundry circles. The function was presided over by the late Mr. W. B. Lake and was an outstanding success. Obviously the war stopped all international gatherings, but the International Committee of Foundry Technical Associations was kept in being, and resumed activities immediately hostilities ceased.

This was a period when the Institute made very considerable progress. It opened under the presidency of the late Mr. C. Edward Williams, a gentleman of particular charm and outstanding ability. His work for the Institute and especially for its Welsh members, is commemorated for all time by an annual lecture carrying his name. He was followed by the late Mr. Roy Stubbs, who is remembered by the extremely efficient way he conducted the council meetings. Two other past-presidents who have also passed away were Mr. Harry Winterton and Mr. J. Hepworth, the latter being a Member of Parliament. Both gave unstinted service to the Institute during their years of office. This decade closed with the late Mr. W. B. Lake presiding. He was president for the first two years of the war period. He had been treasurer for many years, and was more familiar with the Institute's affairs than are most presidents. Under his wise and beneficent leadership, the position of the Institute was undoubtedly enhanced. His dictum that the advent of war must not be allowed to stop the activities of the Institute was carried out enthusiastically.

1942 to 1951—War to Peace

The opening of the most recent decade 1942 to 1951 was characterized by shortages and controls for the economic utilization of raw materials and preparations for the intensification of the war. Amongst these was paper, and the JOURNAL assumed the format of a theatre programme. This was not such a bad thing in a way, because it resulted in a much closer study of its contents, and with it a better appreciation of the technical Press, which has since persisted. One of the ill-considered pieces of legislation was the concentration of the ironfoundry industry. Because of the protest organized by the Council of Ironfoundry Associations, the action taken was limited to the Metropolitan area. The idea of concentration was based upon a survey which showed that the production per unit area of floor space within the ironfoundry industry contained wide variations, as it always will until nothing but six-inch cubes are cast by all of them. The campaign certainly established the need for a strong employers' association, a need which persisted with the coming of victory, and is likely to continue. As a consequence of this concentration affair, there was a notion bruited abroad that the ironfoundry industry was inefficient, and the Council of Ironfoundry Associations was called upon to report. This was undertaken by Mr. A. R. Knowles, the then director. As one cannot report without figures, ironfoundry statistics were born, and for the first time in history, the annual output of iron castings was recorded. From the first year 1945, each succeeding year has shown increasing production.* Having established that in general the industry was not exactly inefficient, the next step was the creation of the "Garrett" Committee (as it later became known, after the name of its chairman, Sir William Garrett), the report from which made various recommendations for improved amenities in foundries generally.

One of the committee's recommendations was the provision of bathing and washing facilities which were well established by the industry before the publication of the Report—so much so that founders received commendation from the Chief Inspector of Factories. Canteens, imposed by law during the war upon all sizeable industrial concerns, became during this decade part and parcel of factory life, and so long as food rationing continues, will remain so. Much more would have been done to meet the suggestions of the "Garrett" Report, but for the control imposed upon new building construction.

The immediate post-war years were also noteworthy for the "crazy rush to export everything manufactured," including much-needed machine tools and generating plant for re-equipping our own industry. The talk about nationalization of the iron and steel industry and its ultimate consummation was a disturbing factor, as the fabric of the finance for the industry's research and other activities was dependent on an agreement between the ironmasters and the C.F.A. The benefits accruing from this sensible arrangement have been outstanding.

Other Co-operative Development

The era also saw much communal activity in the non-ferrous foundry industry. The Association of Bronze and Brass Founders and the Association of Light Alloy Founders both came into being. The former immediately initiated a technical committee, which was commendably active, and produced one Report of outstanding merit. The new associations gave much consideration to the unification of "conditions of sale," costing and cognate activities. The use of non-ferrous ingots carrying guaranteed properties became widespread during this era, with great benefits to the industry and national economy. The help given by the suppliers of these ingots to the smaller foundries in the production of sound test-bars was greatly appreciated.

The steel foundry assumes added importance in wartime. There were encountered many difficult problems, but, due to the very friendly relationship established between members of the British Steel Founders' Association, they were overcome by co-operative action. Before the war, the Association was somewhat divided in opinion as to whether it was part of the iron and steel industry or the foundry industry. In recent years, a compromise has been reached with the statement that it is part of the engineering industry! Since the war, the Association has set up its own Research Division, and thus has underlined its determination to be regarded by the public as being an independent industry.

As soon as the war was over, there was a rush of industrial commissions to Germany to report on that country's industrial undertakings and techniques. Teams were sent by most sections of the foundry industry, but so far as this activity is concerned, we have not noted that it resulted in any outstanding benefit. One item, however, referred to by an American commission, was the " C " process; yet this development has been shown to be of such a novel character that it would have become known to the world through normal business channels.

Productivity Missions

In very recent times, a second series of trips has been made to the United States to investigate the higher productivities achieved in American industries, and to report upon those capable of being applied to British manufacturing conditions. The first team to go was organized by the British Steel Founders' Association and led by Mr. Frank Martin, O.B.E. It was very forthright, and its technical recommendations have been the subject of successful experiments ever since. The same, however, cannot be said of its political observations. Next, there was the Report of the visit by the Grey Iron Founders (jobbing), led by Mr. S. H. Russell, followed by a third covering Brassfoundry headed by Mr. Frank Hudson. For the full implementation of all three, energetic Government action is essential, but much can be done by each individual foundry executive applying appropriate data to his own particular practice.

Recent Technical Advances

Of technical developments which have come into being during the last decade, a major one is the invention of nodular cast iron. As is not uncommon, two interests working independently are accorded equal authorship. The theoretical concepts and a method involving the use of cerium were evolved by Mr. H. Morrogh of the British Cast Iron Research Association. Simultaneously, metallurgists on the staff of the International Nickel Company brought out a similar iron based on the use of magnesium. This last addition to the family of high-duty cast irons has already found a niche in engineering usage. What its growth will be, it is impossible to state. One thing, however, can be said, and that is the search for nodular cast iron has clarified the metallurgy of cast iron to an extent greater than any other invention in this field.

On the more practical side, there was the original work done by Mr. Renshaw on the basic-lined cupola. This British innovation has received approbation throughout the world, and the very latest reports from the States indicate that like many earlier ones, it will be at the hands of the foreigners that rapid industrial development will follow. Since Mr. Renshaw's work has been published, there has been a revival of interest in hot-blast and water-cooled cupolas. Though not an invention, the creation by the Stanton concern during the war, under the direction of Mr. P. H. Wilson, O.B.E., of the finest steel foundry the world has ever seen, was of great merit. By utilizing largely female labour, a brilliantly-conceived transport system, and a novel, triplex melting system, prodigious quantities of bomb bodies were turned out.

During the more recent years the foundries of the world have given increasing attention to the modernization of the age-old lost-wax process This has resulted in a spate of Papers on the subject. During the war, a number of aircraft manufacturers pioneered much work utilizing this process for the production of turbine blades, but after victory, activity was for a period somewhat restricted. Recently, however, there has been a revival of interest, associated with a markedly widened field of application for what are now termed investment castings. The future for this particular precision casting process is indeed bright.

Long before the 1939 war, Mr. Dan Sharpe showed to British audiences a film showing the casting of grey iron into iron dies by the Holley Carbureter concern of America. The process was not really taken up, though some experiments were carried out, until, during the war, Mr. V. Jobson, of Qualcast Limited, made the first commercial installation of what was by then known as the Eaton-Erb plant, and used it, *inter alia*, for the casting of incendiary-bomb components. Since that time, the plant has found a permanent and important place in repetition iron foundry business.

Post-war Exhibitions

The post-war period, as is not unusual, quickly witnessed the staging of a national exhibition. Carrying the somewhat ridiculous title of " Britain Can Make It," it was in the opinion of the writer the most puerile effort ever staged as a national enterprise. Last year, a second national effort—the Festival of Britain—was organized. With the possible exception of the South Bank Exhibition, for which it was difficult to establish any underlying *raison d'être*, the Festival was quite successful. There were some side-shows of exceptional merit at the Goldsmiths' Hall, Lincolns Inn, and elsewhere. The Engineering, Marine & Welding Exhibition (biennial), the British Industries Fair (annual), and the various trade shows were resuscitated, and well maintained the interest they have invariably aroused. In both 1947 and 1951, latest developments in foundry equipment were housed in substantial sections at the Engineering and Marine Exhibitions of those years.

During the war, a praiseworthy and highly successful effort was made by members and officers of the Institute of British Foundrymen to continue,

as far as possible, normal activities. Some meetings were held during actual raids to the accompaniment of gun-fire, and bomb explosions. It is difficult to assess the reasons for the satisfactory attendances at these meetings, unless it be the limited opportunities there were for social gatherings. No matter what the cause, the Institute during this last decade has made record progress. In the early part it played its full share in such matters as advising on the reduction of fuel-wastage in foundries. Committees were formed, and were active in most areas. The annual congresses held during the war and immediate post-war years, though essentially austere, produced a plethora of excellent Papers. Since the war, highly successful conferences with social getherings have been held in Birmingham, London, Cheltenham, Buxton, and Newcastle. The long-established technical council, under the wise and energetic guidance of Mr. John Gardom, Mr. A. E. Pearce, and Mr. L. W. Bolton, has produced a brilliant series of reports which have substantially enriched the foundry literature of the world.

International Matters

Almost immediately after the war, the writer visited Paris to renew contact with the *Association Technique de Fonderie* and will always remember the warmth of the reception which was accorded him. The next year, 1946, Mr. Makemson organized a visit to the States, where an informal international committee meeting was held. Thereafter, the International Committee of Foundry Technical Associations met annually, and under its auspices excellent congresses were staged in Amsterdam and Brussels. Last year, there was striking growth in the membership of the Committee by the readmission of Germany, and the affiliation of about half-a-dozen new countries. The benefits derived from these international conferences have been appreciated throughout the world's foundry industry.

Education

During the last fifty years the JOURNAL has printed more "tripe" about education than about any other subject, because everyone thinks he knows so much about the subject, whereas in truth the average person is abysmally ignorant. Many writers have not even taken the trouble to ascertain what has been or is being done, before rushing to the typewriter. However, there has been established during the last decade, the National Foundry College, the National Foundry Craft Training Centre, the Meehanite School, foundry apprenticeship schools at Stanton, Newton Chambers, and a dozen or more of the larger foundries. Scotland has not lagged behind, and the light-iron-castings industry has provided noteworthy centres of instruction, whilst again the larger foundries such as Harland & Wolff, J. & G. Weir, have inaugurated high-grade apprentice teaching systems. For adult education, the Institute has organized a series of foremen's congresses at Ashorne Hill. Foundry subjects are taught in a large number of technical schools throughout the country, and during the last ten years an increasing number of candidates presented themselves for the annual examinations organized by the City and Guilds of London Institute. This is the best possible evidence that the latter are being conducted on a sound basis. Finally, an activity not so widely known as it should be is the work being done by the British Cast Iron Research Association in this field, by methods varied to suit needs, including the holding of conferences on group subjects and individual tuition at the laboratories of the headquarters.

Acknowledgments

Of the fifty years covered by this review, the writer has been responsible for the editorial direction of this JOURNAL for more than three-fifths of that time. His thanks must first be warmly accorded to his colleague Mr. L. Fokes, who taught him the routine of the profession. To Mr. Harold Jeans, A.R.S.M., the Chairman of the proprietors of the JOURNAL, are offered grateful thanks for wise advice, and invariable courtesy during the long period of association. To Mr. Barrington Hooper, C.B.E., who, since 1926, has been managing director for the proprietors, appreciation is likewise expressed for the whole-hearted and sympathetic support he has always given to the editorial policy.

Editing a technical journal involves team-work, and the writer acknowledges with gratitude the loyal services given to him by Mr. John Butler, now the secretary of the Council of Ironfoundry Associations; Mr. John Bolton, now with the British Steel Founders' Association, and Mr. "Jimmy" Francis, B.Sc., now on the staff of the Mond Nickel Company. To his present staff, Mr. A. R. Parkes and Miss Jean V. Lowdon, and his colleagues, Mr. Frank Hooper, B.A., Mr. Lovell, Mr. P. Carden, and Mrs. M. Barritt, all of whom have co-operated enthusiastically in the preparation of this Golden Jubilee issue, he gives his warmest and most sincere thanks. In conclusion, he is conscious and appreciative of the co-operation received from the presidents and officials of the various bodies of which this JOURNAL is the official organ. Outstanding amongst these supporting "pillars of wisdom"—for whom lengthy association is only one of many merits—are Mr. T. Makemson, M.B.E., and Dr. J. G. Pearce, O.B.E. More recently, but no less enthusiastically, the co-operation of Mr. Kenneth Marshall, M.A., the director of the C.F.A., has been accorded. Last, but by no means least, the writer is grateful to both advertisers and readers, amongst whom he has countless personal friends, to whom he tenders his thanks for the courtesies he invariably receives from them.

This year's International Foundry Congress is being held in conjunction with the American Foundrymen's Society Convention in Atlantic City, U.S.A., from May 1 to 7. Upwards of fifty Papers are being presented, including exchange Papers from the participating countries of the International Committee of Foundry Technical Associations. The British exchange Paper is by Mr. W. B. Parkes on "Sand Control with Particular Reference to the Prevention of Scabbing." Concurrently, there will be a large exhibition of foundry plant and machinery.

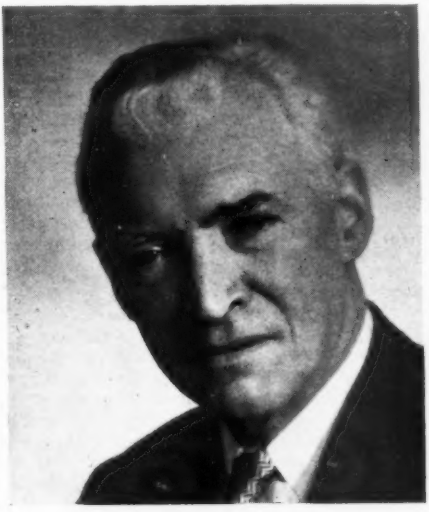
500 years Ironfounding crammed into 50 YEARS

By **J. J. SHEEHAN, B.Sc., A.R.C.Sc.I., A.R.I.C.**

The last fifty years of ironfoundry practice has seen as much progress as the previous 500 years. The beginning of this period saw the transition of methods and processes from art and craft to science and technology. Much else effected and stimulated this change (and the consequent rapid progress)—the availability of machinery, the expansion of the electrical industry, the application of modern engineering principles, the application of modern business methods, of cost-accountancy and time-study, technical educational facilities, the organizations of technical institutions and research associations, the universities the technical Press and the establishment of technical libraries. The progress of this period, however, may best be pictured and explained through the effects of the application of the scientific method upon the ironfoundry industry. The beginning was not spectacular; it was mainly characterized by the gradual application of simple chemical methods and physical principles to the examination of foundry materials, *extending later to the improvement of these materials, and to their better selection for specific applications. With this advance went the application of the scientific method to the control of* foundry processes.

Although Professor Turner's classic Paper "The Effect of Silicon on Cast Iron" was published in 1885, it aroused only academic interest. For many years it had little or no effect upon the industry. Pig-iron continued to be graded by fracture. In the first volume (not the first number) of the FOUNDRY TRADE JOURNAL, page 49, an article appeared deploring the absence of foundry laboratories, and pointing out that England was behind both America and Germany in this respect.

During this early period, the engineers began to specify tensile strengths for cast irons. F. J. Cook in a Paper "Tensile Testing of Cast Iron" FOUNDRY TRADE JOURNAL, vol. 9—pp. 65 and 190 quotes—9 tons tensile on a length of not less than 2 in. Cook objected to the test-bar being "cast-on" and pointed out that often no diameter was specified, thus beginning the long controversy on test-bars, their dimensions and the method of casting them.



Mr. J. J. Sheehan, president of the Institute of British Foundrymen in 1950-51 *and one of the most popular and highly esteemed figures in the foundry industry, is managing director of Coneygre Foundry Company Limited, Tipton, prominent as makers of iron castings for the automobile industry. Born in* 1892, *he was apprenticed to the city and county analyst of Cork, his native city, and later graduated from the Royal College of Science for Ireland and the National University, Dublin, receiving, in* 1919, *Associateship of the Royal College of Science, Ireland. Early in his career, Mr. Sheehan was engaged in metallurgical extraction work and assaying and it was in America where he first came into contact with foundry work, at the foundries of the Ford Motor Company in Detroit. Later he became chief chemist and metallurgist at the Cork works of Ford's and subsequently was foundry metallurgist at Dagenham. Before joining his present Company he was foundry superintendent at Austin Motor Works Limited, Birmingham. Mr. Sheehan has contributed profusely both technically and socially both to foundry practice and the activities of the Institute over many years.*

50 *years' Ironfounding*

Existing State of Knowledge (*circa* 1901)

Around this early period, 1900-1914, the influence of the constituents of cast iron was little known or understood. There existed, however, a spirit of inquiry and a willingness to experiment. No knowledge seemed to exist of the exact influence of total carbon or graphite content in iron—a patent for toughening iron by the addition of wrought iron to the cupola charge was taken out as early as 1846 (Patent No. 11,262.1846 by Sterling) and appeared to have been forgotten—Sterling appears to have produced this toughened iron in sufficient quantity to arrive at definite opinions, as he states that 70 per cent. of pig and 30 per cent. of wrought iron gave the best results.

There is evidence, however, that it was not a period of complete complacency—a Paper by Wüst (*Metallurgical* vol. III pp. 811-820) gave figures showing the effect of P and Si. on the solubility of carbon in iron, and the publication of Stead's work on Fe/C/Si. alloys in a Paper to the British Association in 1910, and another Paper by Stead giving the results of his investigations on the effect of sulphur in iron, given to the Staffordshire Iron & Steel Institute in 1910, show definite interest. Further evidence of the increasing activity of this period is given by the publication of Keep's book in 1902, which included a description of Keep's test for shrinkage and porosity; again Southey in the *Iron Age*, vol. XXVI p. 283, wrote on the neutralization of the effects of high-sulphur content in iron by increasing the manganese content, and demonstrated the removal of hard spots in cast iron by increasing the manganese from 0.16 to 0.5 Longmuir distinguished the difference between annealing and stress-relieving of castings, and published his findings in the *Journal* of the Iron & Steel Institute vol. I in 1909.

Although the growth of cast iron had been known and commented upon by Beddoes to the Royal Society in 1791, it was not until this period (1900-1914) that the first systematic work was begun on this subject, published by Carpenter and Ryan in the *Journal* of the Iron and Steel Institute in 1909, and by Outerbridge in a Paper to the Franklin Institute.

Foundry Practice, Period 1900 to 1914

While the earlier remarks show evidence of the scientific approach to the metallurgical problems of the foundry industry around 1900 to 1914, a corresponding approach was developing towards the problems of foundry practice and processes. This was achieved by the extension of the scientific approach of the then existing engineering and other technological knowledge. Moulding machines began to be more widely used—Tabor, Pridmore and Bonvillain and Ronceray were manufacturing and improving. Moulding sands began to be examined scientifically. H. Ries in the Proceedings of the American Foundry Association 1906, p. 63, proposed tests for permeability, porosity, refractoriness, life, strength and chemical composition, and expressed a belief in the desirability of uniform round grains. Synthetic moulding sand was not discussed extensively, but it is significant of the enterprise of the period that such sands were suggested by W. J. May in the Paper "Artificial Moulding Sand" given in the FOUNDRY TRADE JOURNAL, vol. 12, p. 364 in July, 1910. In this paper, May pointed out the possibility of using silica sand rounded and classified by water action (in other words, using valuable British glacial sand deposits) with the addition of clay preferably added as a slurry. Again this possibility was not immediately developed, and it was not until around 1930 that synthetic sands were used to any great extent, and not until nearer 1940 have they become more widely used, though still by no means universally so.

Sand Practice

The increased use of sand-preparing equipment began to be apparent also, starting with the preparation of the sand on the foundry floor. A sand cutter was developed in the U.S.A. in 1906, capable of cutting (*i.e.*, mixing and aerating) 100 heaps each 60 ft. long in 10 hours; this operation for obvious convenience being performed on the night shift. The changeover from loam cores to oil-sand cores began also in this period, and became very generally used by 1914. E. D. Frohman, writing in the *Foundry* of 1906 pp. 216-218, gave a core-sand mixture mentioning the use of flour, rosin, linseed oil, fish oils and glutrin. The use of dextrine and linseed oil came later, and at a much later period the development of the prepared soluble starches with linseed oil.

It must not be deduced from these references that the change to oil-sand core practice was immediate or, indeed, even speedy. It began with the smaller cores and indeed it was not until the development of sand-testing equipment that it became possible to apply the technique to larger cores due, mainly, to the difficulty of accurately controlling "sag." This control became possible later through green-strength determinations, and through a control of rate of air-drying. It took all of 25 years of development and education to make the use of oil-sand cores anything like universal.

It is a tribute to the present knowledge and scientific control in the foundry industry to know that it is now possible completely to change over a fundamental foundry process within a year; such, for example, as the change from oil-sand practice to the use of synthetic resins, and to envisage the universal use of such materials within as short a period as five years. This latter statement implies a belief in a very much wider spread, or distribution of, scientific knowledge and technical control.

Cupola Practice

Cupola practice began to improve and felt, also, the benefit of the scientific approach to general foundry problems. Much attention was given to cupola dimensions and design, and advantage was being taken of the new knowledge obtained through chemical analysis of the raw materials used. It was not, however, until later, perhaps from around 1918 to the present day, that full advantage was taken of engineering technique so as to develop better handling methods and better instructions to control the volume, pressure and humidity of the air blast.

It is interesting to note that Robert Buchanan, in "Principles and Practice of Foundry Works" (FOUNDRY TRADE JOURNAL, Vol. 9, August, 1907, p. 357), described the use of a basic lining in the cupola. He says the iron was hot and fluid, but the lining failed after six heats. He also had trouble during the first heat owing to reaction between the sand bottom and the basic slag. No analysis was given, so it is not known whether he obtained higher carbon by this method, thus giving the increased fluidity mentioned. The trial was discontinued, evidently through want of sufficient technical experience, and only recently did Renshaw succeed in the project. It must be considered, however, that Buchanan's gallant effort was evidence of the inquiring attitude of his time.

Moldenke's Paper "Modern Foundry Advances," A.F.A. *Transactions*, 1915, p. 343, gave the following as the most notable foundry advances from 1900 to 1914:—

(1) Pig-iron graded by analysis instead of fracture.

(2) Introduction of machinery, especially moulding machines.

(3) The study of raw materials, *e.g.*, sands and fuels.

(4) Machine casting of pig-iron.

(5) The standardization of methods of analysis of pig and cast iron.

(6) Classification of castings by analysis so as to control and permit the reproduction of quality.

(7) The operation of foundries with laboratory aid.

(8) Standard specifications for pig-iron, cast iron and coke.

(9) The introduction of oil, gas, electricity for melting, and the addition of steel and alloys to charge.

(10) The study of physical and chemical properties of cast iron which have taken it out of the list of unreliable materials.

(11) The improvement in working conditions — lighting, heating, sanitation, safety and efficiency, and the development of foundry education.

First War Period

From 1914 to 1918 there is little evidence in our libraries of any spectacular development. This seems to have been a period of consolidation of the advances already made, and the use of them for greater production in the foundries to meet the needs of the emergencies of a war period. It was, indeed, at this period that the increased use of steel in the cupola burden developed rapidly. J. E. Hurst, in 1916, melted an all-steel charge in the cupola with success, and it was in this period also that the Lanz Perlit process was developed in Germany. This process consisted of pouring low-carbon and low-silicon iron into hot moulds, the low-carbon and low-silicon being most readily and economically achieved by high steel additions to the cupola charge.

Post-1918 Metallurgical Progress

From 1918 until the present day, progress became more rapid and more spectacular. Among the metallurgical processes probably the most important advance was the control of carbon content and type, and the control of the microstructure of cast irons. A noteworthy Paper was that on the "Mechanism of Graphite Formation" given by Norbury and Morgan, 1930-36, and that given a little later by Hanemann and Schrader in their *Atlas Metallographicus* in 1935, followed by the spectacular and steady work of Morrogh, leading to the development of nodular structure in iron in the "as-cast" condition and with short heat-treatments.

A reference to the rough chart (Fig. 1) outlines the improvement in cast iron in the last 50 years. It is difficult to picture accurately all the advantages of these new controls and studies; a rough and perhaps over-simplified classification would be that the control of carbon resulted in much improved strengths, and the study of micro-structure and alloy additions improved wear, heat-resistance, easy machinability and corrosion resistance. Table I illustrates the former, *i.e.*, the advantages of carbon control.

The combination of carbon control and the use

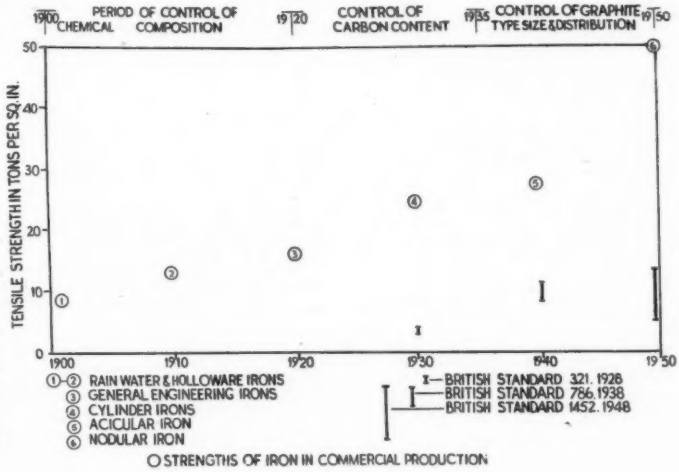


FIG. 1.—*Schematic Diagram illustrating how the Strength of Cast Iron has varied with the Incidence of Three Different Phases of Control. Along with this Evolution there has been a Parallel Development in Applications. Successive British Standard Specifications have mirrored the Trends, each becoming Obsolete as Higher Grades of Iron have been brought into General Practice.*

TABLE I.—*Advantages of Carbon Control.*

—	Date.	Tensile strength (per sq. in.).
British Standard Spec. 321	1928	9 to 11 tons (A. 11 tons, B. 9 tons on 1.2 in. bar).
British Standard Spec. 786	1938	14, 17 and 20 tons on 1.2 in. bar.
British Standard Spec. 1452	1948	7 grades—10, 12, 14, 17, 20, 23, 26 tons on 1.2 in. bar. (Corresponding figures for 0.6 in., 0.875 in., 1.6 in. and 2.1 in. bars.)

of alloys is used to obtain the highest of cast irons, alloys used being notably molybdenum, nickel, chromium and copper; these in various combinations producing the now well-known Ni-resist, Nicrosilal, Silal, Ni-hard, 30 per cent. chromium irons and the acicular irons.

Recently, also, much further improvement, both in control and application, has been made possible by the new technique of inoculating metal, *e.g.*, the addition to hot metal of small quantities of special alloys and materials. It could possibly be mentioned here, also, the considerable influence of the automobile industry on cast iron and its production. This industry demanded, and succeeded in getting, good medium-strength iron (from 16 to 18 tons per sq. in. tensile on 1.2-in. bar), readily reproducible in quantity, for use in the manufacture of large quantities of complicated castings. These were produced by moulding machines and core-blowing machines using mechanization developed by foundry and production engineers, combined with accurate metallurgical control.

It was in this period also that the most rapid advances were produced in the cupola as a melting unit, while other furnaces were being developed and used, such as the rotary furnaces, oil-, gas-fired and solid-fuel-fired and the electric furnaces, both induction and direct-arc. The cupola also received much attention and, indeed, has succeeded in remaining the primary melting unit in more modern foundries. The standardization of the cupola dimensions became a necessity and received much attention. The relationship between the melting rate and the diameter and temperature and stack height, were determined and fixed. Tuyeres sizes and arrangements were studied, notably in the development of the balanced-blast cupola; and the hot-blast cupola was developed (*e.g.*, the Griffin Wheel Hot-blast Cupola—patented in 1907, and by Shurmann earlier in Germany) and (Taft and Hallett—"Balanced Air Feed," in 1945). Water-cooled linings began to be operated and basic linings were studied and used (*vide* Institute of British Foundrymen's Report and Renshaw's Paper of 1943 in the FOUNDRY TRADE JOURNAL) and cupolas incorporating all these improvements may indeed soon be necessary due to the deterioration and scarcity of raw materials.

Moulding Sands

Perhaps the first sustained attempt in England to study moulding sands was Boswell's Memoir on British Resources of Foundry Sands—published 1918, followed by a later publication on a Comparison of British and American Foundry Practice, with special reference to the use of Refractory Sands—published by Boswell in 1922. In the first publication, no physical tests were undertaken, only mechanical and geological analyses, as this volume was mainly an examination of British resources of natural sands. In the second volume, British and American foundry practices were compared and reference was made to the use in America of synthetic sand. These synthetic sands were little used in this country at that period—probably they were first used in the steel industry. Round about 1930, synthetic sands began to be more generally used in the iron foundries, and in 1940 their use received a considerable impetus due to the rapid expansion of the iron industry to meet the demands of the armament requirements in the war period.

A considerable help in their development and application was due to the publication of the standard tests of the American Foundrymen's Association in 1924, 1928, 1931, 1938 and 1944, and to the sands committees of the British Cast Iron Research Association, Institute of British Foundrymen, the Iron and Steel Institute and the B.C.I.R.A./I.B.F. Joint Sands Committee, and many Papers published in the technical Press, so many, indeed, on every aspect of sand technology in this period that it is impossible to give full references.

These latter bodies were mainly, at first, interested in the control of sand quality, and in the instruments and equipment necessary to give this control, but it was gradually and generally found that ease and accuracy of control could best be obtained by the use of synthetic sands, that is, the manufacture, in the sand-mixing equipment available, of a moulding sand by the addition of silica sand, clay and coal-dust, in accurately predetermined quantities and of selected quality.

Parallel with this development in moulding sands went similar methods of preparation and control of the sands used for core-making. It is difficult, too, in this connection, to say whether development was due to scientific control or that the requirements of more rapid and more accurate core manufacture demanded this scientific application. It is certain, however, that scientific control in the core-shop has laid the foundation for further rapid developments, *e.g.*, the use of coreblowers, and the choice now available of a new variety of materials for core-making, such, for example, as the use of synthetic resins.

Dissemination of Knowledge

One significant factor which has had as much effect as any of the foregoing on foundry industry, has been a wider dissemination throughout every section of the industry of all this accumulative knowledge, technique and practices; the consequences of this more widespread knowledge, indeed, are incalculable. The progress of the industry is no longer dependent upon the knowledge of a few, but must be accelerated by the combined and co-ordinated knowledge of the many. It is hard,

indeed, to know what occasioned this widespread information; the first place, perhaps, must be given to the existence of a more general and higher standard of education, and to the establishment of technical schools, training centres, the Foundry College, the universities and research associations and to the activities of the technical institutes in the iron industry, mainly, to the Institute of British Foundrymen; but outside the educational facilities there also exists the work of the technical Press and auxiliary influences, such as the influence of competition and the influence of higher standards of wages and of living. Sometimes, too, there is the influence of what at first may have been considered restrictions, such, for example, as the influence of the present shortage of raw materials—other materials are either sought and used or more economical methods in their usage developed. There is a considerable influence, also to be taken into consideration, of change in attitude or frame of mind—there is no longer that striving for secrecy which isolated for some time many improved arts and techniques from general application. The modern general attitude of open display and discussion stimulates rapid development and improvement. A wide and free discussion of technical Papers at branch meetings of the technical institutes illustrates this point—a little knowledge is contributed individually, resulting often in a wider knowledge for many more.

APPENDIX I

In numerical order, Braidwood* gives the following important points in foundry development (in each case, notes on relevant published data are appended):—

1. Rise in physical properties; (Impact test developed 1947).
2. Standard of cupola operation greatly improved:—(quotes: Rambush & Taylor quenching a cupola, I.B.F. Proc. 1944-1945); also: patent by Longden for external heater for blast 1939; Taft and Hallett—Balanced air-feed 1945: Walbro' 1938 (report by Faulkner on that date, developed about 1935): Basic Cupola—Renshaw 1943: Use of low-melting-point ladle additions to obtain a variety of compositions from the same base metal (Braidwood I.B.F. Proc. 1948).
3. Electric furnaces for special irons. (Twigger quoted I.B.F. Proc. 1942/43.)
4. Cupola control tests, (Control Tests for Grey Cast Iron I.B.F. Sub-committee T.S.6 1945-1946).
5. Shrinkage, and gating and feeding:—Timmins, on shrinkage (B.C.I.R.A. 1941); Fry, on gating and feeding "Preliminary Investigation of Metal Pouring by Cine-Radiography" (I.B.F. Proc. 1944-1945): exothermic mixtures.
6. Mechanical handling, (Mechanical Handling in Foundries, by Mechanical Development Subcommittee, I.B.F. Proc. 1943-1944).
7. Moulding and core sands—Sheehan, I.B.F. Proc. 1939-1940.
8. Core-blowing (Blakeborough's film "Sand Storm Secrets."
9. Die-casting (Qualcast, Pollard, Redshaw & Payne, I.B.F. Proc. 1946-1947).
10. Heat-treatment—I.B.F. Sub-committee T.S.17, 1946-1947.
11. Welding—I.B.F. Sub-committee T.S.23, 1945-1946.

* "A Decade of Progress in the Ironfounding Industry in Great Britain" (presented to the *Association Technique de Fonderie*). See FOUNDRY TRADE JOURNAL, March 24 and 31, 1949, and Appendix II of this article.

APPENDIX II

Below is a summary from other literature giving a review of developments in foundry practice over the period 1900-1950, and published during that period:—

1. FLETCHER (J. E.) and PEARCE (J. G.) Continental foundry developments. B.C.I.R.A. Research Report No. R.15. October, 1925.

Describes developments, principally in Germany, in general ironfounding practice and special irons. Comments on care taken over preparation of moulding sand, existence, even in small foundries of foundry laboratories (although no sand-testing was undertaken) use of soda ash for desulphurization of cast iron, employment of wedge tests, production of chilled castings and use of ferro-alloy briquettes.

2. EVEREST (A. B.) Thirty years of progress in cast iron. FOUNDRY TRADE JOURNAL, 1939, v. 60, May 4, pp. 366-367.

Abridgment of Paper given to various branch meetings of the Institute of British Foundrymen. Covers period 1909-1939. The writer points out that, in 1909, pig-iron grading by fracture received some attention but grading by analysis was in its infancy. Cast irons of tensile strengths ranging from 5 to 8 tons per sq. in., in current production. First national standard specification for cast iron 1928. Major development 1914 to 1918 control of carbon by additions to cupola charges of steel scrap. Alloy cast irons not developed until after 1918, and not in general commercial production until after 1928. Improved melting techniques and use of ladle additions appeared during period under review.

3. ALLAN (J.) Two decades of foundry practice. FOUNDRY TRADE JOURNAL, 1940, v. 63, December 5, pp. 361-363, 372.

Covers period 1920 to 1940. Refers to superseding of hand-ramming moulds by the use of Sandslinger, jolt and squeeze machines; spraying and skin-drying of moulds; scientific control of foundry processes, especially sand testing; use of synthetic sands, influence of use of electric furnaces upon production of high-strength cast iron. The writer comments on the "deplorable neglect" of apprentice-training common at the period of his article.

4. FAULKNER (V. C.) Ironfoundry practice, 1919-1939. FOUNDRY TRADE JOURNAL, 1940, v. 62, March 14, pp. 208-210.

Abridgment of Paper given to the Manchester Association of Engineers, junior section. Chief developments noted; increased attention paid to foundry layout, improved sand-handling equipment and methods; introduction of sand grading

and testing with special reference to the standard test methods first published by the American Foundrymen's Association in 1924, introduction of conveyors for removing castings, and of core-making machines, use of sand mixers, increased use of rotary furnaces fired by oil or pulverized fuel. The writer draws attention to the increased tensile strengths available in cast iron from 8 to 14 tons per sq. in. in 1914.

5. BRAIDWOOD (W. W.) Ten years of progress in foundry technique in Great Britain. *Fonderie*, 1948, No. 36, December, pp. 1401-1416. (In French.) Abridged translation in FOUNDRY TRADE JOURNAL, 1949, March 24, pp. 253-260, March 31, pp. 283-287.

Comprehensive survey of the years 1938 to 1948, referring to the earliest British standard specifications for cast iron and their requirements, as evidence of the increased strength of cast iron. Ultimate tensile strength expected in 1928 11 tons per sq. in., had increased by 1938 to 14, 17 and 20 tons per sq. in. and to a maximum in 1941 of 23, in 1948 of 26 tons per sq. in. Other features of the period under review were; development of special cast irons, as *e.g.* acicular cast irons (1942); improved foundry training; increasing use of mechanical aids; appearance of completely-automatic moulding machines and core-blowing machines; mechanical chargers for cupolas; increased use of electric and oil-fired crucible furnaces; development of special types of cupola such as the hot-blast (1927) and basic-lined cupolas (1942). Reference is also made to the development of the Eaton-Erb method of die-casting iron, the wider application of heat-treatment to cast iron, especially for hardening and stress-relieving, and improved methods of fettling such as Hydroblasting.

6. BALLAY (M.) and CHAVY (R.) Cast iron developments during the past twenty-five years. Proceedings of the International Foundry Congress at Amsterdam, 1949, pp. 55-64; (in French).

Very detailed and comprehensive survey of developments between 1924 and 1949. The writer points out that very limited resources were available to the foundrymen in 1918. The influence of graphite shape and quantity upon the properties of cast iron was barely guessed at, alloyed cast irons were little used and heat-resistant irons were limited to the low-chromium and low-manganese types. The principal advances during the period were the development of improved heat-resisting cast irons of the manganese-silicon and nickel-silicon types (1935), corrosion-resistant castings, special cast irons such as the austenitic; nodular and acicular irons obtained by modifying the graphite shape; the technique of inoculation, especially by ladle additions of ferro-silicon or nickel, developed since 1925; use of steel mixtures; increased use of electric furnaces. The writer points to the increased demands made by successive American and British standard specifications as evidence of advances in the quality of cast iron produced during the period. Twenty-one references and diagram illustrate the increase in strength of cast iron over period 1830-1936.

Acknowledgment

The précis of papers on recent foundry practice was prepared with the assistance of the library staff of the British Cast Iron Research Association.

How We Have Changed

The first volume of the FOUNDRY TRADE JOURNAL had a 5 by 7¼ in. type area, double column. In the first 12 months it ran to 480 pages as a monthly, and stayed with this format until 1908, when the pages had increased to over 700 in one year. In 1909 the type area was increased to 6⅛ by 9 in., still double-column measure. The JOURNAL became weekly in 1921, increasing its type area to 6 by 11 in., and over six months ran to over 500 pages. Late in 1927, the type area was increased to 8¼ by 11 in. and three columns were introduced. The largest single volume (physically) was in 1939, which incorporated a special annual review number covering 1938, a Congress Number and subsequent issues containing proceedings of the International Foundry Congress held that year in London. (In addition to 400 foundrymen resident in this country, the Congress was attended by about 200 overseas delegates.) The total number of pages for the six months was nearly 600. This size (8¼ by 11 in.) was discontinued owing to war restrictions, and during 1942 was reduced to a 6 by 7 in. format. Economies in space were introduced at this time in type size and illustrations, so as to continue to present the events and techniques of the time adequately. Even on the cessation of hostilities (and several times subsequently) paper restrictions again restricted both size and freedom of layout of the JOURNAL, yet, in 1949, the pages had increased to nearly 800 per volume. The type area per page was increased to 6 by 8¼ in., much in the interests of standardization, in January, 1950, and there was also a slight change in type size to make it more readable. Consequent on the increased page size, illustrations, too, were better presented. It is hoped to keep to this present format in the foreseeable future, as it is a standard paper cutting, and of course size variations are cordially disliked by readers, bookbinders and librarians alike. Very few of the early volumes are known to be in existence, although, of course, complete sets are kept for reference in the offices of the JOURNAL and H.M. Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C.2. It is a continual source of surprise that photostat copies of articles from the JOURNAL of 30 or even 40 years ago are still being requested. Of course, some articles are out of print within a very short period.

50 YEARS

Evolution of the Equipment Industry

By **J. BLAKISTON, M.I.Mech.E.**

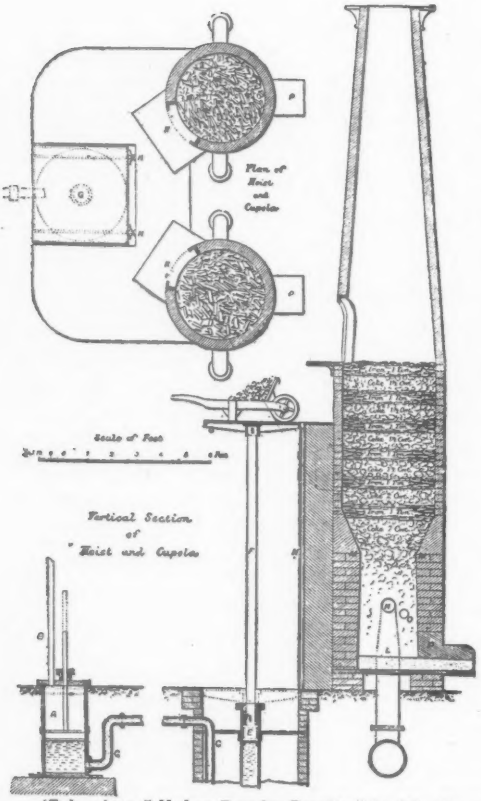
When writing of the foundry equipment and plant of fifty years ago, care has to be taken to avoid decrying the achievements of those times. In many cases the company directors of those days were just as go-ahead as most of the progressive individuals of to-day. Although at that time managers were less hampered by bureaucratic restrictions, labour had to be handled just as carefully by whosoever was delegated to that task, in the same way as operational labour always will be, as long as the individual is allowed to exist as such.

On looking back through the earlier issues of the FOUNDRY TRADE JOURNAL it is noted that many bold building conceptions were erected which, under present-day conditions, could not be repeated on account of the excessively high capital cost which would be incurred, and it would be correct to state that many of these buildings are still in existence to-day, and after minor modifications still stand as a monument to past enterprise.

The type of engineering work at the close of the 19th century differed considerably from that of to-day, and the foundrywork at that time catered for a much heavier type of component, with the repetition portion concentrating in the textile machinery and railway-component sections. Similarly, the light castings industry, catering for the building trades, appeared as a trade unto itself, with a flourishing artistic section, as fashion dictated ornamental ironwork, ranging from fireplace overmantels to building adornments.

Electricity was just coming into universal use and the implications of its adoption were not then fully understood. There was no such thing as an apprentice-trained electrician, the bulk of the electrical knowledge available having been picked up by any skilled man who was sufficiently enthusiastic to take an interest in this new development.

Mr. J. Blakiston is one of the pioneers of foundry mechanization as it is known to-day. He was apprentice-trained at the Clarence Iron Works of Bell Bros., Limited, and later became draughtsman on plant development and reconstruction. After amalgamation with Dorman Long & Company Limited, he was promoted to superintendent of the engineering shop. Subsequently he transferred as works manager to the Middlesbrough Iron Works, and was engaged on organization of the foundries. In 1936 he was appointed by William Asquith, Limited, to manage their subsidiary, Modern Foundries Limited, Halifax, and later, pioneered training female labour to undertake all heavy foundry operations. In 1944, he undertook the reorganization of a large group of foundries in the Martin-Burn organization in Bengal, India, and two years afterwards commenced practice as an engineer and foundry consultant on his own account. Mr. Blakiston is a member of the Institute of British Foundrymen, the Institution of Mechanical Engineers, and the Institution of Production Engineers. His educational activities are well-known, and he has presented many papers to the Institutes of which he is a member, and to other learned societies.



[Taken from "Modern Foundry Practice," by John Sharp (published 1905).

FIG. 1.—*Early Layout of Two Cupolas, served by a Hydraulic Lift.*

Metals

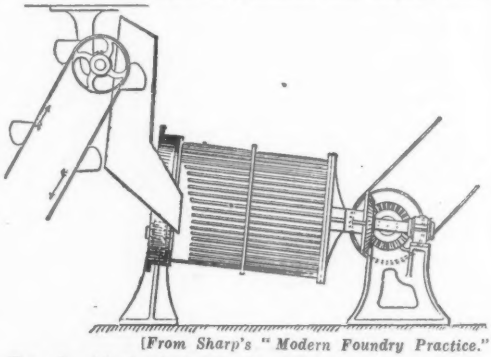
In the same way, the metals in common use were somewhat different from and fewer than the many which are in vogue to-day, and were mainly confined to the ordinary grey-iron, high-phosphoric mixtures adjusted by hematite additions, together with straightforward bronzes and brasses, the only other general exception being malleable iron, which was well-established. Aluminium was practically a chemical curiosity, while steel castings were then in their infancy, and generally regarded with distrust. In those days, welding techniques had not been developed, and the absence of this recovery method, coupled with the cutting tools then available in the machine-shop, ruled out many of the alloys and metals which are common to-day.

Early Plant

The end of the Victorian era when British industry was on top of the world was conspicuous for the amount of mechanical engineering ingenuity introduced to overcome problems of operation, by methods which would to-day appear to be elaborate. It must be remembered, however, that the commonplace of to-day in regard to electric plant, proprietary units and proprietary materials was then practically non-existent. The foundry operator had to solve many of his problems and make the equipment, and do all this from scratch without any outside help or guidance. The typical plant and equipment of the average foundry would not extend beyond the melting plant, consisting of alternately-used cupolas or natural-draught air-furnaces, drying stoves, a limited amount of sand-preparation equipment, cranes, and in some cases specialised moulding machines of a simple nature. There were other facilities, mainly to assist the fettling and dressing of castings, and it is probable in this section, where more up-to-date mechanical aids to production were more apparent, that the sand-blast plant and pneumatic chisel had already become established, together with grinding machines, including flexible-shaft units. It must be remembered that the only common type of prime-mover then available was the steam-engine, occasionally supplanted by the gas-engine, and power transmission was confined to rope and belt drives, with hydraulic-fluid transmission as a major refinement in the better-equipped foundries. Air-power transmission for moulding-machine operation was the exception, and it will be noted that many moulding machines advertised in this period were specified to work on either air or steam on the assumption that it was easier to use steam direct than to convert it by a prime-mover into compressed air with the corresponding losses. Air pressures, on account of inefficient equipment, were rated much lower. In some ways, the heat dispersed through the shops and on to the moulding-machine pattern-plates may have been an unremarked asset which has had to be replaced to-day by special shop-heating and individual systems of pattern-plate warming. On account of transmission difficulties, portable plant was the exception. Portable dryers—beyond coke braziers—were very rare, and when used had to be run in conjunction with a centrally-located shop-air draught system.

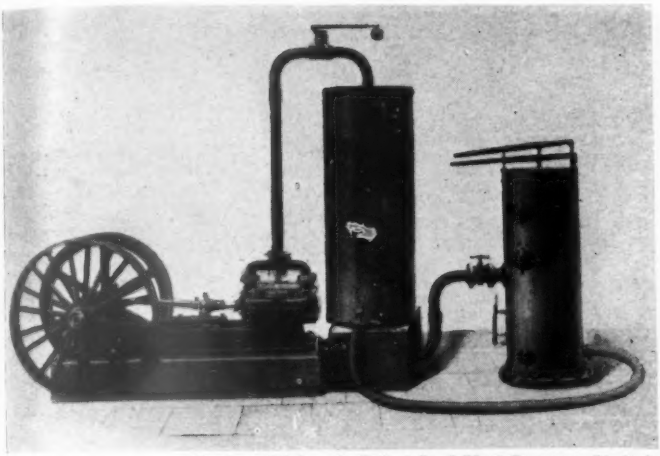
Labour

Labour was relatively plentiful, and although the



[From Sharp's "Modern Foundry Practice."

FIG. 2.—*Mechanical Riddling Machine for Foundry Sand; note the Use of a Bucket Elevator.*



[Courtesy Tilghman's Patent Sand Blast Company, Limited.

FIG. 3.—*Early Model of a Compressed-air Sand-blast Apparatus with a Flexible Blasting Pipe (circa* 1904).

skilled founder received a good wage, averaging over 40s. per week, which represented a high purchasing value for those days, it was considered by many senior executives to be uneconomic to install the improved methods which were becoming known, the general attitude then being that it was easier to replace a man than to repair a machine breakdown, or, putting it more crudely, the policy was to follow the easiest course. Even at that time, economic repercussions, although inevitable, usually lagged a considerable time behind the cause. Another aspect was the inherent pride in individual skill by the craftsman, and the attitude was that mechanical aids and helps were only adopted by the foreigner on account of his ignorance of skilled methods instead of realising that in actual fact the foreigner was starting where his British counterpart was leaving off. Another factor which retarded the general acceptance of foundry mechanical development was the general policy of restrictive labour which was coming into prominence, and already authoritative sources were predicting the end of British world superiority in commerce in favour of that of America and the Continent. The worst of these predictions have not been fulfilled, but nobody now denies the loss of this superiority and the necessity to exercise every effort in order to retain what has been left.

PLANT 50 YEARS AGO

Returning to the foundry of the early 1900s and taking each item of plant as if it were being considered by the then-known facts, the following items of plant would most likely have been reviewed:—

Cupolas

There were many types of cupolas from which to choose; in fact, as many as are in vogue today, embracing systems of blast control which differ very little from the present-day balanced-blast cupola, through a variation of designs even extending to a cupola worked on a suction principle, combining its functions with those of a gas producer. If possible, the contour of the land would be taken into account to facilitate charging, but where this was not possible, the charges would be lifted to the cupola platform by means of a direct steam winch, with the hydraulic hoist as alternative (Fig. 1), or even a counter-balanced gravity water-tank system. While these systems catered for the larger cupolas, many of the smaller furnaces had their charges carried up to the platform level by manual labour, which may account for the number of cupolas of low stack height associated with the practice of that time. Although fixed cupola-bottoms were common, the drop-bottom cupola was coming into use, but was still looked upon with suspicion, and as a potential source of danger when operated on large furnaces. The blowing equipment would comprise a paddle-type semi-positive blower directly coupled to a steam engine, although in some cases a gas-engine driving a fan *via* belting was regarded as a modern innovation. Hot-blast cupolas were not then in use in iron foundries but were quite common for smelting iron ore in conjunction with blast-furnace plant and Bessemer converters which were then a normal method of producing steel in bulk. The blast was heated in the blast-furnace hot-blast stoves and an extremely high degree of melting efficiency was obtained.

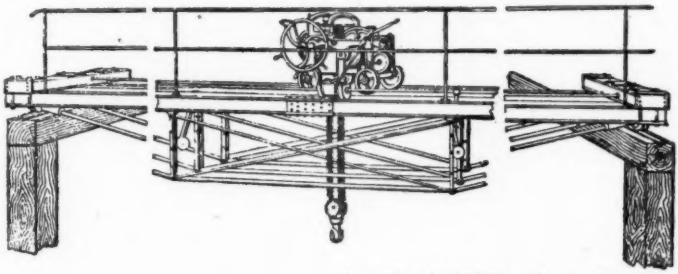


FIG. 4.—*Hand-operated Travelling Crane, operated from the Platform incorporated. Some types of Crane were equipped with a Steam Engine on the Overhead Platform for providing a Power Drive.*

[From Sharp's "Modern Foundry Practice."

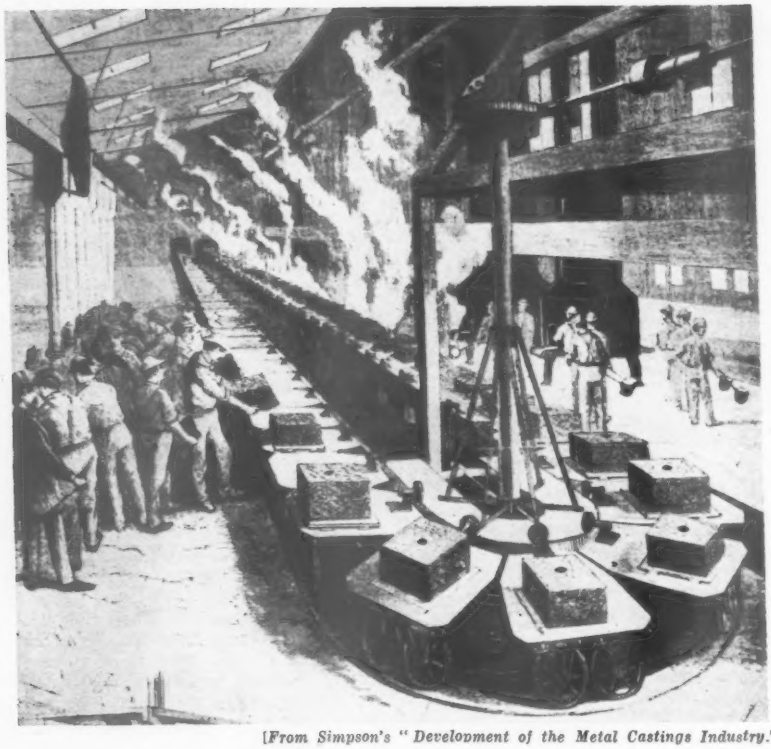


FIG. 5. — *Mould Conveyor, installed in 1890, showing integrated Moulding, Pouring and Cooling. Apparently, Snap-flask Moulding is being carried out; Drop-bottom Cupolas seem to be in Vogue and Additional Interest is provided by the Worm Drive Overhead for the Mould Conveyor.*

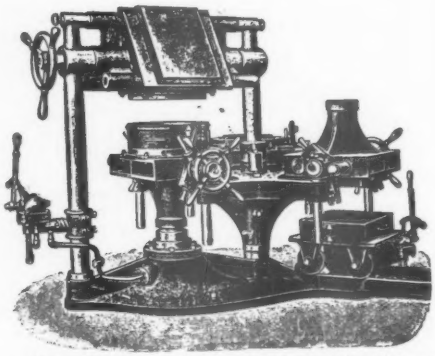
[From Simpson's "Development of the Metal Castings Industry."

Sand Milling

There were definite schools of thought as to the advisability of milling foundry sands, and the decision was very often influenced by the source of supply. In many cases, no milling equipment was installed and extra toughness was imparted to the sand by treading it out prior to riddling it manually over the pattern. This system is still practised in a few foundries. Although milling was not general, it had become accepted that some form of riddling or screening was desirable to contribute towards obtaining a better finish on the casting surface. These rotary sieves or reciprocating riddles in some cases were operated mechanically (Fig. 2). Pan mills were used more often for the preparation of loam and tough sand for dry-sand applications. Many experiments were made as to the best type of roller, and the result of this early experience has determined present-day practice for sand milling.

Mould and Core Drying

Mould and core drying would be carried out at that period by the lighting of large open fires either in suspended baskets inside the mould or on a sheet of metal placed above the mould. Large stoves were in general use, but little attention was paid to their efficiency, and it was assumed that it was the heat and not the circulation factor which governed good drying technique. The provision for air circulation other than that induced by natural draught was the exception, but many ingenious systems for burning producer-gas were tried out in some of the larger foundries.



[From Treiber's "Foundry Machinery" (published 1913).

FIG. 6.—*Rotary Moulding Machine with Turnover Plates.*

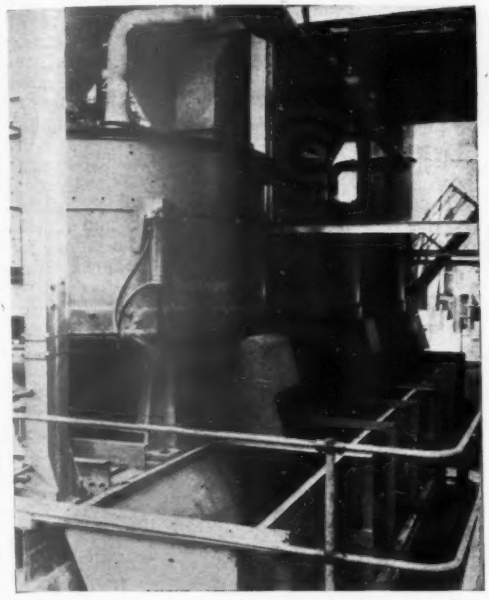


FIG. 7.—*Battery of Modern-type Batch Sand Mills, by August's, Limited. These were quite recently installed in a Large Mechanised Foundry in India, where the whole scheme was carried out by British Engineers.*

It was already realised that there was a demand for a compact efficient type of stove for drying small cores and proprietary units were already appearing on the market. A FOUNDRY TRADE JOURNAL advertisement of 1902 illustrates a unit of this nature equipped with five trays complete with combustion stove and valves at a named cost of £18, which is rather a startling contrast to the present-day prices.

Fettling

In the fettling shop a number of systems were already fully proved and established. Although in most of the factories the cleaning of castings still utilised only hand methods, some of the more progressive foundries had already installed sand-blast systems, although up to that time they only used a natural silica-sand abrasive and not shot (Fig. 3). With the introduction of manufactured grinding wheels, then known as emery discs, it was generally realised that an efficiently-operated grinding head was an asset in every foundry, but these machines were run without any attempt at guarding or dust suppression. Again, at this date it was possible to buy a 24-in. double-headed grinding machine for £24, a figure less than the present-day cost of a pair of stones.

Lighting and Amenities

Amenities for the moulder were practically non-existent. Some of the more-advanced firms provided a mess-room, usually a place where a boy warmed any meal brought to the works by the operator. Washing was done in a bucket anywhere in the foundry, and the only source of hot water was that obtained by the operator placing his bucket over a hot casting. Although one may look askance at this lack of amenities, it must be understood that, by the standards of those days, they were accepted by the operator, and when attempts were made by the more enlightened firms to install improved facilities, it was only in exceptional cases that they were fully appreciated. The lighting usually consisted of open-flame gas-burners and any concentration of illumination was obtained by means of a wick lamp. In some cases, electric-arc lighting was being introduced, but the dazzling effect and the contrast when the moulder looked down the mould, created certain objections to this method of illumination. No provision for heating was made, as in most cases it was found, on account of the steam transmission pipes

FIG. 8.—*Modern Core-turnover Device incorporated in a Roller-conveyor Line for Heavy Cores. Two Main Tables are carried between the Circular Trunnions which are rotatable on Rollers and One of the Tables is adjustable for Clamping the Corebox between. For Loading and Unloading, the Tables come into line, respectively, with Arrival and Delivery Sections of the Roller Conveyor.*

and a number of open fires used for drying purposes, that the foundries were heated to a reasonable degree of warmth in winter, and were sometimes excessively hot in summer. As one cynical owner remarked, the only heating system he would consider was that generated by a hard-driving foreman.

Lifting and Handling Facilities

Although very few aids other than cranes and skips were available for handling, the average operator, on account of the manual effort involved, became extremely efficient at handling large tonnages of material with the minimum of effort, avoiding waste and excessive lifting with an extreme degree of efficiency.

In some cases, the tonnages handled were phenomenal and the number of box-parts put down per working day would still compete to advantage with many present-day mechanised projects. When working at this rate, the moulder learned many short cuts, which were the " know-how " of his productivity. It is rather ironical that a lot of that horse-sense and slickness is not so apparent to-day, and in many cases has to be planned and demonstrated by a third party.

The cranes available were hand-operated for the lighter lifts, while the heavier cranes, although hand-operation was not excluded, were generally driven by a complicated rope or sliding-shaft system. Some foundries preferred to have a steam boiler and driver on the crane carriage itself (Fig. 4).

Hydraulic lifting equipment was installed in many foundries, and this system attained a high degree of efficiency. The smooth operation has yet to be equalled by the more modern systems which have supplanted it, and to witness a heavy ladle of metal being transferred the full length of a foundry bay by swinging it from one pillar crane to another must have been a spectacular sight.

Electrical cranes were just making their appearance and were usually of heavy construction, operated on direct current. The problem of that day was one of providing an efficient and reliable control system, and the use of electric cranes did not become universal until this troublesome problem had been solved.

It will be noted from the above description of past operation that flow mechanisation was practically non-existent as it is known to-day, although there were some cases of its application in a specialised form in some of the more progressive textile foundries, the larger of which would employ up to 1,000 operators, to cater for an industry at the peak of its prosperity.

Continental Developments

The impact of foundry inventions in the first decade or so of this century came from abroad, particularly America, France and Germany. As previously stated, these developments were decried in the United Kingdom on account of the local confidence in the superior production to be obtained from the inherent skill of the British workman, although this argument could not be applied to

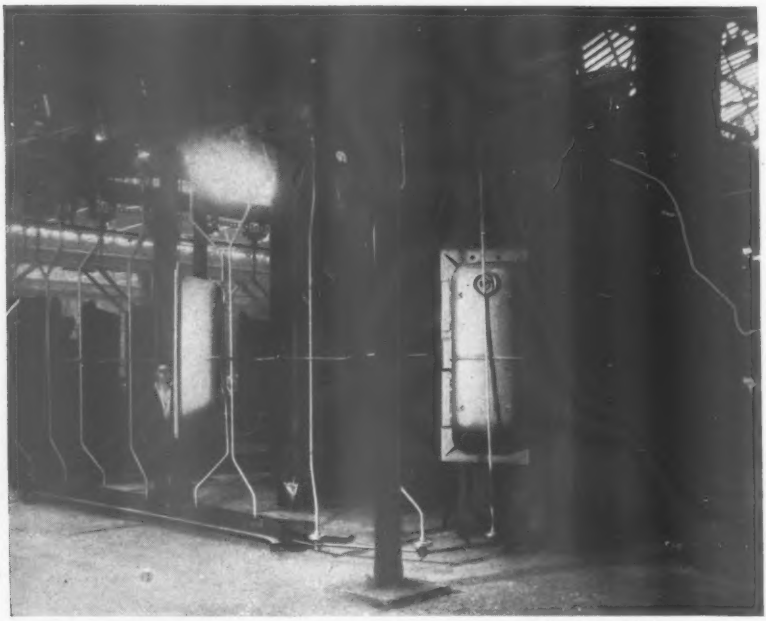


FIG. 9.—*Overhead Conveyor-type Wheelabrator Plant for Mechanical Shot-cleaning of Domestic Bath Castings. This Plant is provided with Five Impellor Wheels, 19½-in. dia., located in Staggered Positions on one side of the Chamber. The Carrier Hooks are arranged to rotate as they pass in Front of the Wheels.*

(*Courtesy Tilghman's Patent Sand Blast Company, Limited.*

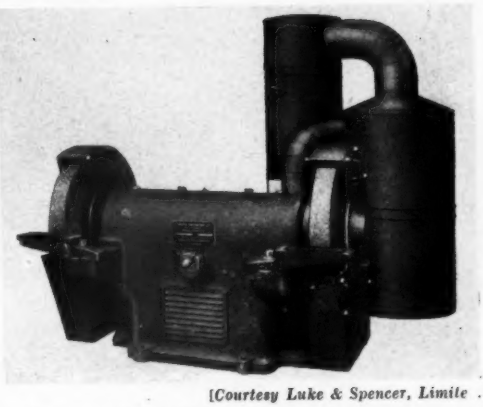
France, which country probably had a longer tradition of skilled moulding techniques.

These Continental developments seemed to concentrate on providing mechanical appliances for eliminating the skill of, or a tedious process carried out by an individual, and it is difficult to pick out any specific machine in present-day use which did not have an early prototype then made as efficiently as technical development would permit with the materials and knowledge available. Already attempts were being made at full plant mechanisation, and a mould conveyor was installed as early as 1890 with integrated moulding, pouring and cooling stations (Figs. 5 and 6).

POST-WAR (1914-18) PROGRESS

The end of the 1914-18 war heralded a marked change in engineering trends. As is usual during a war period, considerable technical advancement had been made, which in due course was turned to the art of peace. The advent of the motor-car and the generally lighter trend in engineering presented what appeared at that time revolutionary demands to the foundry industry. These were coupled with a rise in labour values and at the same time there was the necessity to meet increasing foreign competition. In many cases, the foreigner now took precedence in some of the new developments in production methods, which in turn cheapened the price of the article in spite of repeated wage increases. Unfortunately, many concerns, in an endeavour to meet these changing conditions, purchased foundry machinery and plant, expecting it to solve all the problems, without having the slightest conception of the implications involved and the services necessary to bring these units into economic production. It was quite common for companies to instal a moulding machine or a Sandslinger in a foundry and immediately expect the machine to operate and produce a flow of moulds equal to the high-output figures quoted by the suppliers, which had been obtained in highly-efficient organisations abroad. It was not generally realised that the machines represented only a small item of the cost and that moulding boxes, tackle and other services complementary to the installation would be necessary, in aggregate exceeding the cost of the machine many times. As a result of this misconception there were a number of failures, and in many cases first-class machinery was discarded and a reversion was made to the old production methods, for, as a few years passed, wages were on the decline and ample labour was becoming available.

Some of the more farsighted firms, however, had realised the magnitude of the problem and called in the assistance of advisers from abroad, and even purchased complete mechanised units for importation into the country. The industry today owes much to the spade-work and courage of these pioneers who established and proved the correctness of the foundry mechanisation trend. The new mechanised plants thus established in this country were talked about, and in spite of some labour opposition (which seemed to vary in different districts), the industry as a whole came to realise that in many sections of the foundry business it was a case of adopting mechanical aids even to the extent of full mechanisation or to retire from the scene.



[Courtesy Luke & Spencer, Limited.

FIG. 10.—*Latest Model, Heavy-duty Floor Stand Grinder, with Self-contained Dust-extraction Plant.*

British Equipment Development

Several British firms specialising on the manufacture of conveying and elevating equipment undertook the adaptation of their product to the purpose of handling foundry materials, and as a result of these pioneer efforts in a new field, other firms gradually took up the manufacture of foundry conveying equipment, making it their speciality. It was very soon realised that the handling and conditioning of sand and the manufacture of continuously-operating machinery to work in conjunction with metallurgical processes was a specialised science. Sand, in its various conditions, behaved in an entirely different manner from other materials, with its characteristics varying with each new installation. Although up to then (the early 'thirties) the British industry had lagged behind, as a result of the number of calls made on it for versatile and extreme foundry operating conditions, the mechanised foundry industry of this country gradually came to the forefront, and it can be stated to-day with some authority that it has now reached a degree of proficiency such that it virtually holds a world lead. This was proved in a practical manner during the 1939-45 war, when many restrictive labour practices were dropped and the industry proved itself capable of building up phenomenal outputs at extremely short notice utilising mixed labour forces.

DEVELOPMENT OF FLOW-PRODUCTION

The acceptance of flow mechanisation established the necessity for new types of plant and modifications to many of the accepted moulding-machine designs, although generally the basic principles of operation remained the same. These developments,

[Courtesy Pneulec, Limited.

FIG. 11.—*Combined Sandslinger and Turnover Moulding-machine Unit for the Production of Large Moulds.*

directly associated with full mechanisation, are mainly as follow:—

Sand Mills

The earlier type of sand mill had to be re-designed so that it could be discharged into the sand system without stopping. In the same way, it could be instantaneously loaded, thereby increasing the capacity of the mill to nearly double that previously employed. This system is known as batch milling (Fig. 7). The next step was the adoption of the continuous sand mill, and between the two, most foundry milling and preparation requirements are now catered for. On some projects, the sand mill merely becomes a component to facilitate the additions of moisture and other ingredients, natural or synthetic. The control of these operations is fast becoming an exact science and devices to assist in this control by electronic and other methods are being developed.

Conveyors and Elevators

Practically every type of conveyor finds a place in the scheme of foundry mechanisation, ranging from gravity-roller, belt, pulley, slat, pendulum, and a host of other variations generally modified to meet foundry conditions. The elevating systems, apart from direct crane lifts, appear to be concentrated on the vertical belt and bucket type, alternatively with the inclined or vertical skip-type of elevator. Development is taking place utilising pneumatic systems or direct mechanical projection, which have achieved some degree of success in specialised cases.

Knock-outs

The mould knock-out station has become one of the most important units of a mechanised project and the mechanical knock-out was often imported until 1945, when several knock-outs of British manufacture, both mechanical and electrical, were placed on the market and achieved considerable success. When considering a mould knock-out, an unenviable choice has to be made between the factors of moulding-box damage or a prolonged shake-out period, although industry has now the choice of either mechanical or electrical systems, one of which usually meets the requirements with a high degree of efficiency.

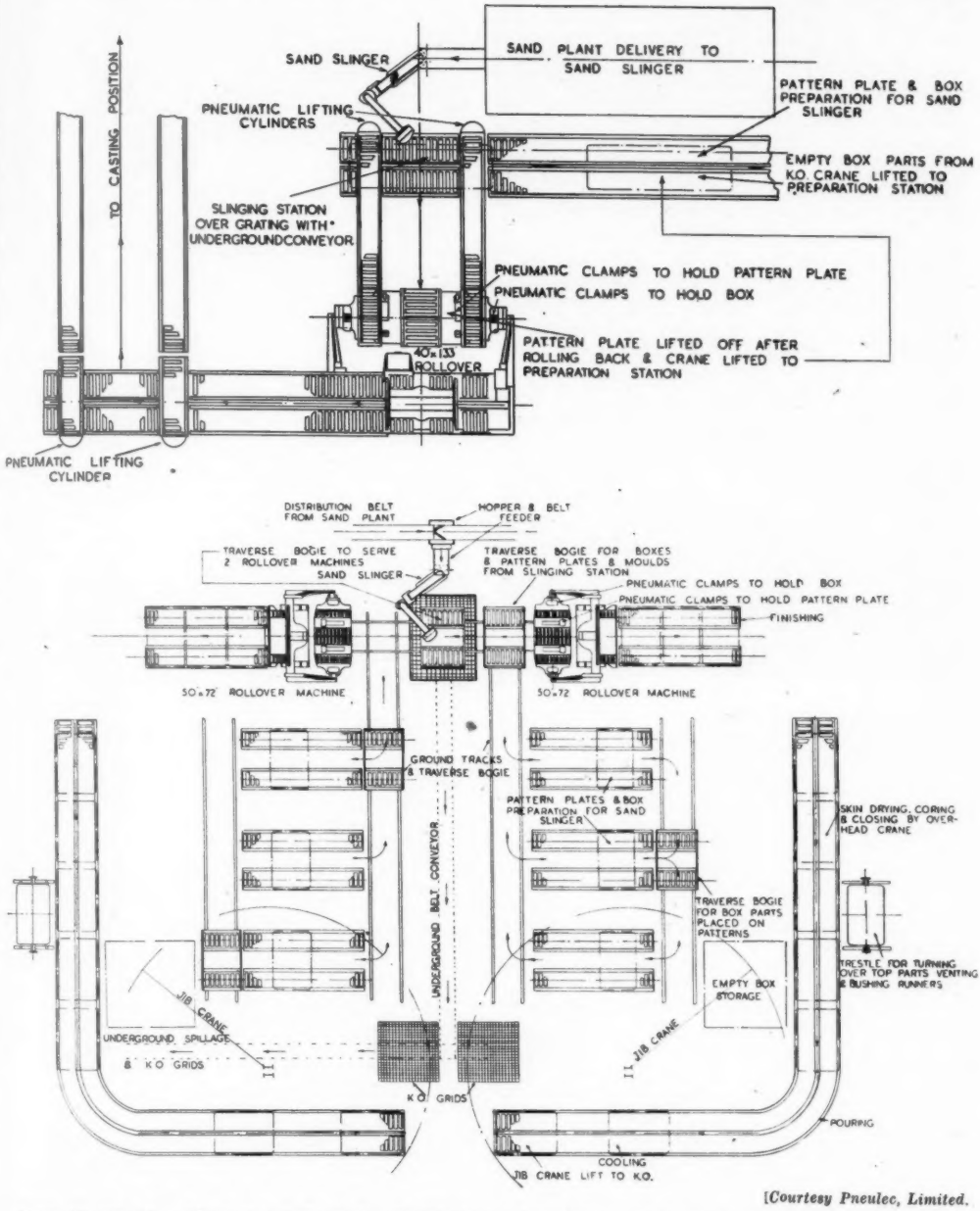
The knock-out area, on account of the concentration of process work, *i.e.*, the ejection of hot castings and the starting point of the sand system and moulding-box return, becomes one of the focal points of the foundry. Not only are difficulties encountered here because of the heat and fumes released, but, unless careful planning is resorted to, continuous manual effort is required, which is unattractive to operators. Considerable developments have taken place to eliminate the dust and fume hazard and to secure partial separation of the materials involved, so minimising the arduous labour required. The realisation as to the necessity of removing the hot castings as quickly as possible from this vicinity to avoid heat concentration has led to the adoption of several ingenious devices, usually culminating in a continuous conveyor system, which often combines cooling facilities with ultimate delivery of the castings to the fettling shop.

Mould Stoves

The construction of mould stoves has become a specialised art. A modern stove utilises heat with the utmost conservation, re-circulating the air in some instances to achieve this. It has become fully realised that heat-insulation and not massive construction is the criterion of a good stove, and a modern design allows for the repeated expansions and contractions to be accommodated so that cracks in the fabric, which cause heat losses, do not develop. Temperature control has become an essential of the installation, whilst alternative fuels

are used with like degree of success, depending on the economics of the site position.

Mechanical fittings have been studied so that the minimum of effort is required to operate the stove doors; in some cases these doors are power-operated, while special locking devices enable a


SAND SLINGER
SAND PLANT DELIVERY TO SAND SLINGER
PATTERN PLATE & BOX PREPARATION FOR SAND SLINGER
PNEUMATIC LIFTING CYLINDERS
TO CASTING POSITION
EMPTY BOX PARTS FROM KO. CRANE LIFTED TO PREPARATION STATION
SLINGING STATION OVER GRATING WITH UNDERGROUND CONVEYOR
PNEUMATIC CLAMPS TO HOLD PATTERN PLATE
PNEUMATIC CLAMPS TO HOLD BOX
40"x 133 ROLLOVER
PATTERN PLATE LIFTED OFF AFTER ROLLING BACK & CRANE LIFTED TO PREPARATION STATION
PNEUMATIC LIFTING CYLINDER
DISTRIBUTION BELT FROM SAND PLANT
HOPPER & BELT FEEDER
TRAVERSE BOGIE TO SERVE 2 ROLLOVER MACHINES
SAND SLINGER
TRAVERSE BOGIE FOR BOXES & PATTERN PLATES & MOULDS FROM SLINGING STATION
PNEUMATIC CLAMPS TO HOLD BOX
PNEUMATIC CLAMPS TO HOLD PATTERN PLATE
FINISHING
50"x72" ROLLOVER MACHINE
50"x72" ROLLOVER MACHINE
GROUND TRACKS & TRAVERSE BOGIE
PATTERN PLATES & BOX PREPARATION FOR SAND SLINGER
SKIN DRYING, CORING & CLOSING BY OVER-HEAD CRANE
UNDERGROUND BELT CONVEYOR
TRAVERSE BOGIE FOR BOX PARTS PLACED ON PATTERNS
TRESTLE FOR TURNING OVER TOP PARTS VENTING & BUSHING RUNNERS
EMPTY BOX STORAGE
JIB CRANE
UNDERGROUND SPILLAGE & K.O. GRIDS
JIB CRANE
K.O. GRIDS
POURING
COOLING
JIB CRANE LIFT TO K.O.

[Courtesy Pneulec, Limited.

FIGS. 12 AND 13.—*Alternative Layouts for the Mechanised Production of Heavy Moulds utilising Sandslingers and Herman Rollover Machines.*

FIG. 14.—*Battery of Four Large Cupolas with Common Mechanised Charging Arrangements using a Snout Crane handling Drop-bottom Buckets.*

close fit to be maintained to minimise heat loss. In the same way, frictionless stove-bogeys have been devised to reduce the effort required to move these heavily loaded units to a minimum.

Developments in core-making have called for different types of mechanical continuous stoves both of the horizontal- and vertical-chamber types, working on a fixed time cycle. These types have become extremely popular, particularly the vertical one, which requires a minimum of floor space for highly-efficient operation, coupled with an extremely high output.

Core-making

The change which has taken place in the common foundry component during the last fifty years has demanded an entirely new conception of core-making. Core-making methods have been improved at the same time as the general acceptance of oil-sand and other binder practice, which, in turn, requires special mixing plant. On account of the large weight of cores often required per ton of castings produced, parallel developments as regards mechanisation have had to take place in this department, and conveyors and other devices for handling are just as necessary to this section as they are in various other foundry departments (Fig. 8).

Special core-making machines have been evolved, generally using air as a sand-carrying medium, this being the basis of what is now referred to as core-blowing practice. Core-blowing machines are generally classified into reservoir and cartridge types of which there are a number of designs now in existence.

Fettling and Dressing

It was pointed out earlier in this article that the fettling and dressing department was the earliest section of the foundry to receive attention with regard to mechanical improvements, and this interest has been continuously maintained. The original pioneer emery grinding wheel has given place to a high-speed grinding unit using special vitrified stones. The Grinding of Metals Act, which came into force in the early 1920s laid down certain stringent regulations with regard to dust suppression and now the fettling department in many foundries is tending to become one of the cleanest of the foundry sections. It is realised that apart from the safety of the worker, it is in everybody's interest to maintain cleanliness, and nearly all plant is now equipped with dust-collecting ducting. Large intricately-cored castings can now be de-cored by means of the Hydroblast system using an abrasive carried in a water system which cuts out hard cores and ashes, with an absence of dust, thus simplifying an unenviable foundry task which operators are generally reluctant to undertake. Blasting plant using sand has been supplanted by the general use of metallic abrasives and a further trend is for the unit to have no operator inside it but to work on its own automatic cycle, the shot being flung on to the components to be cleaned by means of high-speed rotating impellers. The method of charging and presenting the component to the stream of metallic grit or shot has again become a matter for specialised consideration, and it can be claimed that these developments have resulted in a noticeable improvement in working conditions and at the same time produced an infinitely superior product (Fig. 9).

Power-operated hand tools have shown only minor advances recently. Pneumatic hammers, apart from quality, have shown very little change in design, although operators have now accepted these aids as part of the general equipment of the average foundry. Portable grinding machines have shown a more spectacular improvement, although the original flexible-shaft machine still has its use. The adoption of the latest high-speed grinding wheels has necessitated higher speeds which have been met by modifying the design of the electric or air motors integral with the unit (Fig. 10).

In many cases, the original tumbling barrel still proves to be one of the most efficient cleaning methods for some of the smaller types of components. The early objections to these units have been met by the addition of dust-exhausting systems combined with acoustic repression chambers, which, in most cases, renders the plant practically sound proof.

Portable Plant

The common use of electrical power-transmission has enabled several of the earlier ideas of portable plant to be implemented, and it is now the normal practice to have small portable units in operation in the foundry immediately adjacent to the place where the service is required. The most-common units are portable mould driers, the correct operation of which has done much to eliminate objectionable smoke and dust created by the open-fire method of drying. There are also several makes of sand-conditioning and cooling units, one of the most popular being the " Royer," which can throw conditioned sand directly into a mould or hopper.

The hazards associated with electrical distribution for portable tools have been reduced to a minimum by the introduction of the high-cycle method of power distribution, where the current is reduced to a safe voltage, while the periodicity of the current is stepped up, enabling extremely high rotor speeds with a maximum starting torque to be achieved. This electrical system has proved excellent for small-wheel grinding operations and heavy stock removal with a minimum of effort and has lightened the effort required by the foundry dresser.

Moulding Machines

The principles of the earlier type of moulding machine have now been consolidated into various accepted systems of machine moulding, the basic methods being jolting, squeezing and slinging. It is now the practice for a modern machine to combine one or more of these methods as part of its sequence of operations, although this merely represents the replacement of manual ramming by mechanical means. The latest refinements of moulding machines have been to adapt them to flow mechanization, which may be a combination of the turning-over, stripping and box loading and unloading devices.

All the above motions in some cases are being brought under the operation of an automatic-sequence control. The full realization of these potentialities has been brought to fruition in the case of some of the larger types of moulding operations by combining the Sandslinger method with an independent turn-over unit, linking the plant together by conveyor so as to permit instantaneous box loading and unloading. By including sequence pattern changes, it has been possible to achieve phenomenal outputs (Figs. 11, 12 and 13).

Power-operated moulding machines, where they have adhered to the earlier principles, have had their contours re-designed to give a streamlined effect so as to facilitate cleaning. At the same time, the design has been modified to give better protection to the moving parts from the incursions of abrasive sand. The majority of the machines are worked by compressed air at a nominal pressure of 80 lb. per sq. in. In some cases, machine movements are controlled by air/hydraulic motions to ensure smoothness of action. The magnetic moulding machine has come into use and has proved very effective for plate-like components. Hand moulding machines are still used for some applications, but in most cases these machines have remained unaltered from their prototypes.

The last fifty years has witnessed the establishment of centrifugal casting of pipes, wheel-blanks, etc., to a commercial basis, and during this period this process has become the established method of pipe production. Although the centrifugal casting system has been known for a long time, a considerable amount of technical research was necessary before the process could be perfected. This had to be backed by a combination of mechanical design which practically ruled hand craftsmanship out of the picture. Present-day research indicates that this centrifugal spinning can be improved much further to include castings ranging from thin-walled pipes to cast-steel gear clusters.

Cupola Practice

Mechanical charging of cupolas of all sizes has now become an accepted method and can be fully justified on most installations. There is a wide range of systems available, many of which incorporate weighing facilities which fit into a stockyard layout with the object of reducing handling labour to a minimum (Fig. 14). Many experiments have been made as to the thermal economies to be derived from controlled hot-blast systems, and the introduction of basic-lined cupolas, along with the problems of the high heat-conductivity of the basic materials, has directed research work into the possibilities of water-cooled installations. At the present date, these systems have proved satisfactory for certain specialized processes, but as yet have not been generally adopted. As the price of fuel and the cost of labour progressively increase, it is obvious that many of these heat-conservation experiments will enter into more and more commercial undertakings.

Conclusions

In conclusion it can be stated that over the last half-century the British foundry-equipment industry has established itself with a high reputation throughout the world, even penetrating into those countries from which the original ideas sprang. This specialized industry has reached such proportions as to warrant the establishment in 1925 of the Foundry Trades Equipment and Supplies Association, the principle and objects of which are to promote and support the welfare of foundry equipment and supply traders. During the recent war, this Association was re-organized to give increased service to the foundry industry both at home and overseas, and at the request of the Board of Trade, an export group has been formed, which indicates the growing importance of this section of industry.

Since the publication of the first issue of the FOUNDRY TRADE JOURNAL fifty years ago, practically every foundry development has been reported on in an unbiased manner, which has made this magazine one of the most widely-circulated technical journals in the world, and the JOURNAL should be included in allocating credit to the whole industry for turning within its lifetime the equipment side of foundry-work from a meagre importing unit to a healthy exporting industry.

The Industry's Mouthpiece

(*Continued from page 2*)

bodies on all matters of general interest to the light-metal castings industry; (*ii*) to consult on all technical matters such as alloys and other specifications, standards of quality, processes and design, and generally to promote and maintain a high quality of product; (*iii*) to investigate and report on new developments and applications and thereby to facilitate progress on sound technical and commercial lines; and (*iv*) the constitution of the Association does not permit the control of prices or labour rates. The membership of the Association represents approximately 70 per cent. of the tonnage production of light-metal castings.

FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION

Formed in 1925 by direct sponsorship from the JOURNAL, this Association has as its objects: "to promote, support, and protect the welfare and interests of foundry equipment and suppliers' traders, to act generally in the co-operative spirit for its members on questions of broad policy, particularly as regards relations with Government departments, and as regards raw materials, and to afford means of discussion within the industry on questions of principle which arise from time to time." An atmosphere of mutual give-and-take has thus been engendered among members, keen and competitive between themselves, towards the common good. Not least in the international field has this Association proved its worth, by helping to bring about a change from being an importing to an exporting country in foundry equipment, to the tune of some £1 million annually. In technical matters, the Association is increasingly active; members have recently collaborated, *inter alia*, in the production of reports on fumes from cores and are participating in work going forward on dust elimination and on working conditions generally. The Association is organized under a president (this year Mr. W. E. Aske), and Council, and has as its secretaries Peat, Marwick, Mitchell & Company, 94/98, Petty France, London, S.W.1. Membership is by election, and subscriptions among the 59 member firms are arranged to cover administrative expenses only.

INSTITUTE OF VITREOUS ENAMELLERS

A non-profit-making technical society formed in 1934 to cover technical development and progress of the vitreous enamelling industry on sheet and cast iron. Membership is secured by election, after scrutiny of appropriate status, academic or industrial qualifications, and is open to all firms and individuals interested in the production, application, and use of vitreous enamels, and vitreous-enamelled products. In the general interests of its 500 or so members, the Institute promotes the exchange of technical information, provides an authoritative and independent source of reference and arranges library and educational facilities. A primary objective is to sponsor and examine critically research both in home industry and abroad and to disseminate and encourage the adoption of worthwhile developments. To this end, sectional meetings—Northern, Midland and Southern—are held throughout the year, and an annual national conference and a Spring conference are organized. The secretaries are John Gardom & Company, Ripley, Derbyshire, and this year's president is Dr. J. E. Hurst, J.P.

COUNCIL OF IRONFOUNDRY ASSOCIATIONS

The Council was formed in 1941 as a federation of associations to represent ironfounders on a national basis in all matters of common interest. It is comprised of 15 member associations, connected with which are 20 local associations; the British Cast Iron Research Association and the Institute of British Foundrymen are also affiliated. Firms comprising the Council's membership produce in aggregate 70 per cent. of the total iron castings output of Great Britain and Northern Ireland. In addition to looking after the interests of ironfounders on a national scale, and in particular, pressing the Government departments for adequate supplies of raw materials for the whole industry, the Council guides and gives voice to the industry's policy on such matters as development and modernization. It has promoted measures and services to improve ironfounding efficiency and it has worked to increase juvenile recruitment and raise the standards of training. It largely contributed to the setting-up of the National Foundry Craft Training Centre at West Bromwich in 1948. The Council collaborates closely with the British Cast Iron Research Association through various committees of each, and has encouraged joint research into foundry dust and fume elimination. Its chairman is Mr. N. P. Newman, and its director Mr. K. Marshall, with Mr. J. W. Butler as secretary, the offices being housed at 14, Pall Mall, London, S.W.1. Included amongst participating associations are the Ironfounders' National Confederation and the National Ironfounding Employers' Federation, which, with their many district associations and branches, represent mainly the engineering and jobbing ironfounders in the country not specifically covered by other specialized employers' associations. The latter include the Automobile Ironfounders' Association; British Ironfounders' Association and British Bath Manufacturers' Association; British Grit Association; British Malleable Tube Fittings Association; Cast Iron Chair Association; Cast Iron Axlebox Association and National Ingot Mould Association; Cast Iron, Heating, Boiler and Radiator Manufacturers' Association; Cast Iron Pipe Association; Cast Iron Segment Association; Greensand Pipe Founders' Association; and the National Association of Malleable Ironfounders.

BRITISH CAST IRON RESEARCH ASSOCIATION

The British Cast Iron Research Association was formed in 1921, and exists to serve the interests of the British ironfounding industry at home and overseas. Like other national research associations, the B.C.I.R.A. is supported financially by its industry and by H.M. Government through the Department of Scientific and Industrial Research. It functions through three main departments—research, development, and intelligence.

Broadly speaking, the research department is engaged on long- and short-term investigations believed to be of value to the ironfounding industry, for instance, the long-standing investigation of the mechanism of graphite formation. The development department deals with day-to-day problems and enquiries received from member-firms, and is responsible for assisting the practical application in members' foundries of discoveries made in the Association's laboratories and elsewhere. The intelligence department is responsible for handling enquiries that can be answered from published sources, and also for the preparation of the Association's literature. In addition, an operational research team has been set up in recent years to visit members, by invitation, and advise on possible means of improving technical and productive efficiency. The headquarters of the Association are at Alvechurch near Birmingham and laboratories are also maintained at Blantyre, near Glasgow. The governing body of the Association is a Council, consisting of elected representatives of member-firms and those nominated by the Joint Iron Council, together with a few specially co-opted members, and representatives nominated by H.M. Government.

THE INSTITUTE OF VITREOUS ENAMELLERS
VEREIN
DEUTSCHER GIESSEREIFACHLEUTE
ASSOCIATION TECHNIQUE DE FONDERIE
INTERNATIONAL COMMITTEE OF FOUNDRY TECHNICAL ASSOCIATIONS
COMITÉ INTERNATIONAL des ASSOCIATIONS TECHNIQUES DE FONDERIE
American Foundrymen's Society
BRITISH STEEL FOUNDERS ASSOCIATION
The Institute of British Foundrymen
THE ASSOCIATION OF BRONZE & BRASS FOUNDERS
Congratulations!

From Mr. Walter L. Seelbach, President of the American Foundrymen's Society

The officers, directors and membership of the American Foundrymen's Society extend sincere congratulations to the FOUNDRY TRADE JOURNAL *on attaining its golden anniversary year in* 1952. *For many years the foundrymen of America have known and respected this excellent publication, which, certainly is entitled to feel a justifiable pride in its constant and sincere efforts to improve foundry practice. We here at A.F.S. have watched with interest the gradual trend toward more scientific practices, paralleling a similar trend in this country, through the pages of the* JOURNAL.

Having attained our own half century mark in 1946, *we can appreciate the sincerity of your efforts, understand your problems, and realize the great contributions you have made to the industry you serve. Congratulations again and may this golden anniversary mark, not merely the past half century of accomplishment, but the next fifty years of certain achievement.*

From Mr. J. J. Marais, President of the South African branch of the Institute of British Foundrymen

On behalf of the South African branch of the Institute of British Foundrymen it gives me great pleasure to contribute to the Golden Jubilee issue of the FOUNDRY TRADE JOURNAL. *The foundry industry in South Africa gratefully appreciates the unending source of information it has derived from this* JOURNAL *during the past years. We are a young country, and therefore, like young people, are not conservative, and are prepared to try any new idea or development without prejudice. We have therefore, taken full advantage of many new ideas you have been able to suggest, and have learnt quickly.*

Through the medium of the Institute of British Foundrymen and the FOUNDRY TRADE JOURNAL, *together with the men who have come to this country from Great Britain and have unselfishly brought with them the knowledge and tradition that is necessary to build up a great and healthy industry, South Africa has progressed so rapidly in the arts and sciences of founding that to-day it has developed into a thriving industry that can hold its own, and produce practically all the castings the country needs. May this spirit of good neighbourliness and free exchange of thought and ideas always exist between us, and may your* JOURNAL *always remain the main medium of communication between our two countries. Wishing you on behalf of all the members of the South African branch of the Institute of British Foundrymen every prosperity and good wishes for the continued success of your* JOURNAL.

From Mr. T. R. Gupta, B.Sc. (Eng.), President of the Institute of Indian Foundrymen

I am pleased to learn that you are bringing out a special Golden Jubilee issue of the JOURNAL *and I should like to say that your* JOURNAL *in the past fifty years has rendered a great service to the foundry trade in particular and engineering industries in general. I hope you will not only maintain the same tradition of your popular* JOURNAL, *but also will further contribute for the advancement of the foundry technique with still more vigour. The industrially-advanced countries have modernized the foundry*

technique so much that the working conditions in the foundries have undergone complete change. Both male and female labour are conveniently attracted by the foundry trade without the prejudice which existed in the past. With the introduction of special-purpose machinery, the foundry trade was called upon to turn out much more complicated work as compared to the past. In spite of late starting, India did not remain unaffected by the modern changes and in the post-war period several mechanized foundries have come into existence, and there is all-round consciousness in the foundry trade about the needs of high productivity. I send my heartiest greetings on behalf of the Institute of Indian Foundrymen and wish you great success in future.

From Mr. John Sissener, Chairman of the Norwegian Stoperiteknisk Forening

It is with the greatest pleasure I take this opportunity to congratulate you upon the Golden Jubilee of the FOUNDRY TRADE JOURNAL. *I can safely say your general work as Editor as well as your detailed work as a foundryman is appreciated in our profession throughout Norway. You not only give us the professional "know how" but certainly also general ideas of great value, an impulse to us all. We wish you good luck and thank you for what you have done for our profession.*

From the late Dr. Guido Vanzetti (Milan), who was President of the International Committee of Foundry Technical Associations

It is with great pleasure that I send a greeting to the FOUNDRY TRADE JOURNAL *on the occasion of the Golden Jubilee of its foundation. I do so as president of the International Committee of Foundry Technical Associations, but let me write you not quite in such an official form, but as an old friend. As a matter of fact, I cannot forget that in* 1917 *you were called by my father to Italy to install an electric melting furnace in our foundry. I am not ashamed of saying that this furnace is still working quite satisfactorily nowadays. Of course, there is not much left of its original installation; it has been changed and modernized in almost all its parts, but in its main features it is always the same furnace that you installed thirty-five years ago—and with its regular efficiency resisting through years and years it seems to prove the solidity of our old friendship.*

Even the collection of the FOUNDRY TRADE JOURNAL, *one of the most precious pieces in our laboratory's library, is not only a valuable guide for our researches, but it also reminds me constantly of my English friends. This magazine can be taken as an excellent example of a perfect balance between the scientific and technological features, making them accessible to a very wide range of people interested in foundry practice. This, I believe, is the main and most difficult problem for the Editor of a technical magazine, the balance between science and practice. This problem the* FOUNDRY TRADE JOURNAL *has well solved, giving great help in the progress and development of foundry practice in your country and in the whole world where your* JOURNAL *is so widely circulated and so much appreciated.*

Finally, allow me to take this occasion to stress another anniversary that foundrymen should celebrate; twenty-five years ago a group of friends from different countries gathered for the purpose of founding the International Committee, over which I have to-day the honour and pleasure of presiding—you were one of these foundrymen and I hope you won't mind if I take this opportunity of emphasizing the concurrence of these two events.

From Mr. J. H. Küster, President of the Verein Deutscher Giessereifachleute

It is a great pleasure to me to transmit to you my congratulations on behalf of the Verein Deutscher Giessereifachleute *on the occasion of the Golden Jubilee of the* FOUNDRY TRADE JOURNAL. *We all know to what extent your* JOURNAL, *the articles in which are followed now as earlier, very attentively by German foundrymen, has materially helped to promote the development of foundry industry. Your weil-known* JOURNAL *is held in high esteem by us through the many connections it has with our own Journal "* Giesserei." *With personal wishes that your* JOURNAL *may in its second half-century continue in the same way with its profitable, far-reaching work, I send you the greetings of my Association.*

From Mr. T. H. Summerson, Chairman of the British Steel Founders' Association

In these days when, although paper is supposed to be in short supply, the amount of it which is piled on to the desks of top executives is greater than ever, it is good that there is a single Journal to be read to keep one in touch with everything that is going on in the British Foundry Industry. If ever the FOUNDRY TRADE JOURNAL *had competitors in serving British foundries—and I personally don't remember one—it has run them out of sight, and its present position is unassailable. I say quite sincerely that it has amply earned its monopoly of the field. Not only does it take great pains to cover all the ground and to overlook nothing worth recording, but it has for years been a propagandist of the conception that the foundry industry is an industry in itself, with problems all its own and with a unity transcending the differences between steel, iron and the various non-ferrous metals in which it works. By so doing, it has helped founders of all sorts to feel a kinship with one another, and thereby to lay the foundations of an edifice of co-operation and mutual support upon which future generations will come more and more to build.*

In congratulating the FOUNDRY TRADE JOURNAL *upon its Golden Jubilee, and in wishing even more power to its elbow, I feel it appropriate to comment upon the extent to which personal interest and attention have contributed to the regard, indeed affection, in which it is held by all foundrymen. While B. H. presides, Jove-like, over policy, to the wisdom of which I have already borne witness, and descends from time to time to deliver after-dinner speeches which are invariably the best of the evening, no meeting of foundrymen is complete without V.C.F. turning up like the proverbial bad penny and moving among the gathering with quiet wit and sage comment.*

From Mr. Colin Gresty, President of the Institute of British Foundrymen

On the occasion of the Jubilee of the FOUNDRY TRADE JOURNAL, *it gives me great pleasure to offer on behalf of the Institute of British Foundrymen and myself personally, sincere congratulations on a memorable achievement. As a regular reader of the* JOURNAL *for some thirty-five years, I have admired its continuously progressive policy in advancing the technical knowledge of the art and science of casting metals and in keeping its readers informed of developments throughout the world. I feel that my congratulations would not be complete if I did not refer to Mr. Vincent C. Faulkner who, as Editor for very many years, has so ably guided its progress.*

From Mr. G. F. Mundell, President of the Association of Bronze and Brass Founders

It is a notable period in the life of any organization, or publication, to attain its Golden Jubilee, and when that publication is one which has existed primarily for the service it can give to any particular section of industry, as you have to the foundry, and kindred trades, not only are congratulations the order of the day, but the sincere thanks of the members of that industry. I therefore extend to you, and your staff, the congratulations, and thanks, which are your due, and the best wishes of my Association for your continued success.

From Mr. A. H. Sturdee, M.B.E., Wh.Ex., M.I.Mech.E., Chairman of the Light Metal Founders' Association

As chairman of the Light Metal Founders' Association, I would like to take the opportunity of congratulating the FOUNDRY TRADE JOURNAL *on its Golden Jubilee and of wishing it every success and prosperity in the future. The co-operation it has always always extended to our Association has been gratefully appreciated.*

From Dr. James E. Hurst, President of the Institute of Vitreous Enamellers

On behalf of the chairman, officials, council and members of the Institute of Vitreous Enamellers, I write to offer our very warmest congratulations on the occasion of your Golden Jubilee. The service that you have been able to render over half a century to the vitreous-enamelling industry in common with the whole of the foundry trades has met with appreciation on the part of generations of workers in these industries. The knowledge of this must be a matter of considerable pride to the proprietors and the staff of the JOURNAL. *It is a special pleasure to me to convey personal congratulations in addition, as an early member of that editorial staff.*

Congratulatory Messages

From Mr. Tom Makemson, M.B.E., Secretary of the Institute of British Foundrymen.

It is with great pleasure that I join in the chorus of congratulations, which I know you will receive on having attained your fiftieth birthday. There must be many in the foundry industry who, like myself, have widened their personal experience as a result of the JOURNAL. *Its real influence, however, has been upon the industry as a whole. During the past fifty years the foundry trade has improved technically out of all recognition, and its various branches, iron, steel and non-ferrous, are soundly organized in strong trade associations. The* FOUNDRY TRADE JOURNAL *has acted as a unifying influence throughout all these developments and has helped to make foundrymen industry-conscious. As secretary of a technical institution, I naturally value the fact that the* JOURNAL *has always had a strong technical bias and I am glad to pay tribute to the part it has played in the development of foundry technique. It is the sincere wish of every foundryman that the* JOURNAL *will continue to flourish even more successfully over the next fifty years.*

From Cav. Di Gr. Cr. Mario Olivo, Vice-president of the Centro Fonderia (Italy).

I keep in my library the complete collection of your JOURNAL, *volume by volume, beginning from* 1922 *until to-day. This collection thus covers a period of thirty years. Therefore, I am in a position to express with pleasure my personal appreciation for the previous work done by the* FOUNDRY TRADE JOURNAL *in many years of activity on behalf of the foundry industry. The* JOURNAL *has indeed made a great contribution to the progress of foundry art and science, and to technical development. As the* FOUNDRY TRADE JOURNAL *is now attaining its Golden Jubilee, I wish to express my most cordial congratulations as past-president and actual vice-president of the "*Centro Fonderia*", and as president of the International Foundry Dictionary Committee, for all the success the* JOURNAL *has achieved.*

On this occasion, my greetings go also to Mr. V. C. Faulkner, Editor of the JOURNAL. *I am happy to state that I am an old friend and admirer of him, because his work always has been of utmost importance and great value. I appreciate his co-operation as an editor and as a technician. He is also one of the founders of the International Committee of Foundry Technical Associations. May the Golden Jubilee,* 1902 *to* 1952, *of* FOUNDRY TRADE JOURNAL *be the beginning of another prosperous and successful period, and may the* JOURNAL *always continue its valuable and outstanding work in the interests of the foundry world.*

From Mr. W. E. Aske, President of the Foundry Trades Equipment and Supplies Association

It is particularly gratifying for me, as president of the Foundry Trades Equipment and Supplies Association, to offer the Association's congratulations to the FOUNDRY TRADE JOURNAL *upon attaining its Golden Jubilee. The Journal is acknowledged by the foundry industry to be the prime means of disseminating technical information and it has established a reputation for the concise but adequate way in which it covers the whole field of foundry practice—as well as for the soundness and common sense of its Editorial comment. It is to be congratulated moreover, upon the proved position it holds in that wide field of foundry interests ; and here, as always, its character presents itself quite unmistakably. It has done so from the earliest days when it became spokesman and commentator upon all matters pertinent to the best interests of the trade. Besides this, it has ever been an open forum for every branch of technical discussion.*

Its primary purpose, however, has always been, and remains, the presenting to the world at large and to the engineering trade in particular, the importance of the foundry in relation to those diverse branches of engineering which the foundry is called upon to serve. Also to give reminder—and this is so frequently overlooked—that in the foundry is the nucleus of all those excellent and shining commodities embraced in the simple term " British engineering products." Beyond all this, it contrives to hold under constant survey all matters touching foundry practice and foundry improvement. Some of the best features of modern foundry efficiency are certainly due to its able sponsoring.

Members of the foundry trades equipment and supplies industry are particularly fortunate in this JOURNAL *through which to offer their wares and sell their services; for through this medium it can be sure the whole of the foundry industry, not only in Britain but in that incalculable overseas market is reached. May I end on a personal note of thanks for the advice and assistance the* JOURNAL *so readily affords, and I would like to take the opportunity of thanking the Editor, Mr. V. C. Faulkner, who was the founder of the Foundry Trades Equipment & Supplies Association, for the generous manner in which he has given his time, his advice and his services for the benefit of the equipment and supplies industry.*

(continued on page 44)

50 YEARS

"Perpetual Interest" *of* Non-ferrous Research

By G. L. BAILEY, M.Sc., F.I.M.

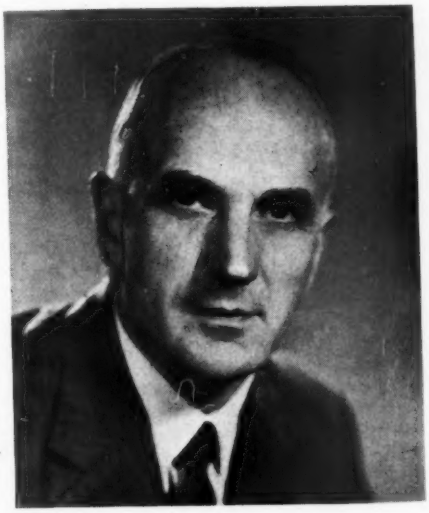
The casting of metals, and more particularly of bronze, silver and gold, dates back to the very beginnings of history and yet, for all the wealth of craftsmanship and experience which has been built up over the centuries and handed down from master to apprentice, until recent years little was known about the real fundamentals of the casting process—what really goes on from the time the molten metal is poured into the mould until the solid casting is knocked-out. In the May lecture to the Institute of Metals in 1921, *Prof. Thomas Turner*[1] *commented "There is just that spice of danger, and that element of uncertainty, in foundrywork which gives to it a perpetual interest," and although very great progress has been made since that day and foundrymen are beginning to get a proper insight into the process, most foundrymen will agree that there is still something of a gamble in making a casting.*

Early Work

The latter part of the last century saw the beginnings of the metallurgists' attempts to study the changes which occur in the structure of alloys during solidification and cooling, together with the effect of variations in alloy composition on these changes. The early work was done on the iron/carbon alloys, but at the turn of the century, in 1903, Heycock and Neville[2] published their work on the constitution of the tin bronzes which has served as a model for the many subsequent investigations into alloy constitution. Heycock and Neville were the originators of the method of following structural changes by the microscopical examination of specimens quenched from the temperature under consideration. This method is now so commonplace as to be accepted without question, but it is as well to remember that it is scarcely 50 years since it was first employed.

Much of the work during the first twenty or thirty years of this century was concerned more with the constitution of alloys, and the effect of changes in structure and composition on the mechanical properties, than with the actual process of casting. This work, while it has not greatly altered the main copper-base alloys, has resulted in the development of the whole series of light alloys now in use, development spurred on no doubt by the existing demands of the aircraft engineer.

It is not the purpose of this article to deal with constitutional studies and alloy development, but



Mr. George Leo Bailey was born in 1901 *and educated at King Edward VII Grammar School, Birmingham, and at Birmingham University, where he graduated in metallurgy in* 1921. *He held a Bowen Research Scholarship in the metallurgy department at Birmingham in the year* 1921-22 *and was awarded the degree of M.Sc. in* 1922 *for post-graduate research. From* 1922 *to* 1930 *he was on the staff of the metallurgical branch of the Research Department, Woolwich. In* 1930, *he joined the British Non-Ferrous Metals Research Association, first as chief officer of the Development Department, later as deputy director, and since November,* 1944, *as director. He is a member of the Inter-Services Metallurgical Research Council and chairman of its sub-committee on non-ferrous metals. He is also a member of the Metals Economy Advisory Committee of the Ministry of Supply. Mr. Bailey was elected a member of the Institute of Metals in* 1921 *and subsequently a Member of Council. He was a founder member of the Institution of Metallurgists of which he is hon. treasurer.*

a few milestones are worth recording. Heycock and Neville's work was followed by a spate of investigations by well-known investigators among whom are names such as Guillet, who is remembered for the " zinc equivalents " of the alloying additions to brass, Carpenter and Edwards who investigated the aluminium bronzes, Wilm who noted the age-hardening properties of Duralumin, Rosenhain who did much of the early work on Y-alloy during World War I, and later Hanson, Gayler, and Haughton of the National Physical Laboratory who investigated such systems as the aluminium/zinc alloys and the aluminium/copper alloys in the early 1920's. Following the work of the Braggs, the investigators have in more recent time been assisted by the use of X-ray diffraction techniques.

Although work of this kind is constantly in progress even to-day, it is true that the metallurgist now has a sufficiently clear idea of the structure of the common non-ferrous casting alloys for ordinary purposes. Work on what is perhaps the more practical aspect of casting metals—the mode of solidification of alloys, the mechanism of feeding, the influence of dissolved gases, grain refinement of the cast structure to mention a few examples—has tended to lag behind.

Solidification of Alloys

Considering the importance of the problem to the foundryman, it is surprising that so little attention has been given until recently to the way in which alloys actually solidify. There have been speculations about this on the part of many authors, but little experimental evidence to justify the views they have put forward. The obvious way of studying problems of this kind is to cast a number of identical moulds from the alloy under investigation and then to " pour out " the liquid metal remaining in them at predetermined intervals to enable the shell of metal left behind to be examined. While this method has given useful results with steel, its application to non-ferrous metals has not been fruitful. Hunsicker[3] for example, examined a number of aluminium alloys, but was unable to obtain satisfactory shells except with pure aluminium, and Richmond[4], studying bronze castings, found that the shells formed were so weak that they could only be retained by using steel nails projecting into the mould cavity to provide support.

Recently, this subject has been investigated by Ruddle[5] at the laboratories of the British Non-Ferrous Metals Research Association, who, instead of using the " pour-out " technique, followed the progress of the solidification of both plate castings and cylindrical castings by taking records from thermocouples placed at various depths within the mould cavities. These experiments have shown clearly that the metals the foundryman has always regarded as having a high shrinkage—pure copper, pure aluminium, and certain alloys like aluminium bronze and high-tensile brass, which freeze over a small temperature range—these metals first form a skin at the mould face which thickens as freezing progresses, there being a sharp division between the solid skin and the remaining molten metal. It follows that all the shrinkage of the metal can be compensated for by metal from the feeders and that castings made from these metals may be made completely sound providing that freezing takes place progressively towards the feeding heads. Thus, properly designed and gated castings made from these metals should have mechanical properties equal to those obtained from corresponding separately-cast test-bars, and a report published by the Technical Committee of the Association of Bronze & Brass Founders[6] giving the actual strengths of typical castings produced in different foundries confirms this.

Low-shrinkage Alloys

There are other alloys which, by contrast with those just discussed, the foundryman regards as low-shrinkage alloys requiring less feeding. Alloys falling within this class usually freeze over quite a long temperature range, sometimes as much as 100 to 200 deg. C. The tests reported by the A.B.B.F. committee, referred to earlier, indicated that, frequently, parts of bronze and gunmetal castings (long-freezing-range alloys) have little more than half the strength of the corresponding test-bars. The view which has often been presented in the past envisages the solidification of castings made from alloys of this type as starting with a shell of solid metal adjacent to the mould face separated from liquid metal in the centre of the casting by a zone of mushy—half-solid, half-liquid—metal.

The results published by Ruddle, however, give a somewhat different picture. He has shown that with sand castings it is more usual for the whole casting to pass through this " mushy " stage and more often than not wholly solid metal and wholly liquid metal do not co-exist in sand castings made from these long-freezing-range alloys. Mass movement of metal from the feeders into the castings is therefore practically impossible in the later stages of solidification and this explains why these alloys appear to the foundryman to have a small shrinkage, since the feeder heads rarely exhibit the piping noticed with the skin-forming metals mentioned earlier. Actually, measurements of the volume contraction during solidification have shown the shrinkage of these alloys to be about the same as the non-ferrous metals which the foundry regards as having a high shrinkage.

Research on Feeding

To overcome the difficulties associated with feeding when making tin-bronze chilled castings, Pell-Walpole[7] has recommended slow pouring through tundishes so that solidification rate of the metal practically keeps pace with the rise of metal in the mould, an application of the results of the work on the casting of brass ingots published by Genders and the present Author[8] several years earlier. In the absence of the mass movement of metal from the feeders into the casting, capillary forces must play an increasingly important part during the later stages of solidification of these long-freezing-range alloys if shrinkage cavities are not to be left between the crystals of metal. The point has been

demonstrated both by Brenner and Roth[9] in Germany and by Adams[10] in this country. Working with aluminium/copper alloys, Adams showed how capillary forces cause the remaining liquid alloy to be drawn towards the coolest part of the casting through the network of channels left between the crystals in the "mushy" castings. With alloys freezing in this manner, feeding during the final stages of solidification must take place through the agency of these capillary forces.

This emphasizes the importance of ensuring that there are steep temperature gradients in the casting from the parts first to solidify to the feeders. Thus, bottom running and top feeding is fundamentally wrong, since the temperature gradients will be unfavourable; the coolest metal will be found in the feeders, and capillary forces will tend to act in the wrong direction. There is now fortunately a growing tendency to run and feed through the top of the casting or, where this is impracticable, into the bottom of the casting or the heaviest section through blind feeders. Even so, it is still not always possible to get an adequate supply of feed metal to all parts of a casting and, particularly with the tin-bronzes and gunmetals, leakage of castings for intended hydraulic application, arising from excessive unsoundness, is by no means unknown. The problem is not quite so simple as was suggested in a paper by Carpenter and Elam[11], entitled "An Investigation on Unsound Castings of Admiralty Bronze: Its Cause and the Remedy" published in 1918. The Authors of this Paper concluded that the foundryman had only to control his pouring temperature between 1,120 deg. and 1,270 deg. C. to cure unsoundness in 88/10/2 gunmetal. Perhaps the foregoing statements will serve to demonstrate how wide of the mark were the early investigators and the great deal that has been learned about this problem since their day.

Grain Refinement

In practice, it is, of course, impossible in many castings to ensure that temperature gradients are always favourable to feeding and a certain amount of shrinkage unsoundness must be accepted. The light-alloy founder can to a large extent mitigate this deficiency by grain refinement of his castings; the use of titanium additions to aluminium alloys for this purpose having been well established for many years. The effect of titanium on the grain size of aluminium alloys was recorded as early as 1930 by Rosenhain, Grogan and Schofield[12] at the N.P.L. in the course of work on the degassing of aluminium alloys by volatile chlorides, and in 1937 Schofield and Phillips[13] pointed out the improvement in mechanical properties resulting from grain refinement. In a recent paper, Cibula and Ruddle[14] have shown in a most striking manner that this improvement in mechanical properties with grain refinement follows largely from a modification of the form of the shrinkage cavities in the casting. They publish two photomicrographs, one illustrating the dangerous form of the shrinkage cavities in a coarse-grained casting and the other the much-less-harmful form of the cavities in a fine-grain casting.

Cibula[15] has also published a theory which accounts satisfactorily for the way in which grain refinement takes place. He suggests that the agents mainly responsible for grain refinement in aluminium alloys are small particles of titanium carbide which act as nuclei on which the alloy may crystallize, and by concentrating these nuclei by centrifuging he has been able to confirm their identity by X-ray analysis. Carbides of several other elements will also act as nuclei, the important considerations being that they should be insoluble in molten aluminium at the temperature of casting and that they should have a crystal structure somewhat similar to aluminium. Nuclei alone, however, will not bring about complete grain refinement. There must also exist concentration gradients in the solidifying metal to inhibit the growth of large grains. With most of the common casting alloys, these concentration gradients are present. This theory of grain refinement is important since it is obviously of general application and may show the way to the grain refinement of copper-base and other alloy castings.

Gases in Metals

Overcoming the results of the shrinkage of the metal during solidification is only one of the problems confronting the foundryman. With most nonferrous alloys, another serious source of unsoundness can be gas dissolved in the metal during melting and liberated on cooling, and much work has been done during the past 30 or 40 years both on the solubility of gases in metals and on methods for removing the gases. Early workers in this field such as Carpenter and Elam already referred to, found a variety of products among the gases extracted by heating unsound castings *in vacuo* and it was obvious that reactions were taking place between the gases at the high temperatures used. More-recent work has pointed to hydrogen as the most prevalent source of gas unsoundness. It was Graham in the middle of the last century who first discovered that some metals absorb hydrogen, but it was not until 1910 that Sieverts[16] first published data for the solubility of hydrogen in copper. Subsequently fresh determinations have been made by Röntgen and Möhler[17]. Iwasé[18] determined the solubility of hydrogen in aluminium in 1916, but later work has thrown doubt on the accuracy of his data. Bircumshaw[19] in 1926 published new figures and since then results have been published by Röntgen and Braun[20], Röntgen and Möhler[21], and again by Bircumshaw[22] in 1935 and more recently by Ransley[23]. Table I gives the approximate solubility of hydrogen in copper, nickel and aluminium.

Although the solubility of hydrogen in aluminium

TABLE I.—*Solubility of Hydrogen in Copper, Nickel and Aluminium*

	Volume of hydrogen (ml. at room temp. and pressure) dissolved by 100 gm. of metal.			
	Solid (at m.p.).	Liquid (at m.p.).	100 deg. C. above m.p.	200 deg. C. above m.p.
Copper	2.0	5.3	10	14
Nickel	18.5	39.0	41	—
Aluminium	Practically nil.	0.2	0.6	1.4

does not seem very high, it should be noted that these figures refer to the volume of gas measured at room temperature; 0.2 ml. of hydrogen measured at room temperature would occupy more than 0.6 ml. at the melting point of aluminium and its liberation from the metal would produce nearly 2 per cent. voids in a casting. It is evident from the older papers on the casting of aluminium that pinhole porosity from this source was a serious difficulty.

Of the elemental gases, it now seems clear that only hydrogen has any considerable solubility in metals. Oxygen dissolves to some extent, but more often it reacts with the metal to form the oxide, which may, however, sometimes be soluble in the metal. Nitrogen seems virtually insoluble, but with some metals a nitride is formed. Compound gases such as steam, sulphur dioxide, carbon monoxide etc. have been shown to dissociate in contact with molten metals. The classic work on this subject is probably that carried out by Allen[24] at the N.P.L. on the equilibrium between steam and copper. In this case, the steam dissociates into atomic hydrogen and oxygen, both of which dissolve in molten copper, the latter as cuprous oxide, but tend to re-combine when the copper cools liberating steam again. This reaction is liable to be a cause of gas unsoundness when casting high-conductivity copper. Atomic hydrogen formed by the dissociation of steam appears to be much more soluble in molten metals than ordinary molecular hydrogen and this emphasizes the importance of preventing access of water-vapour to the metal.

Nickel Alloys

In connection with work on gases in metals, nickel-containing alloys are of particular interest since not only do they usually have a considerable solubility for hydrogen, but they can also dissolve both carbon and oxygen, these two elements tending to recombine during the solidification of the alloy with the liberation of carbon monoxide gas. Baker and Child[25] studied this reaction at the B.N.F.M.R.A. about 10 years ago and concluded that it was mainly responsible for the pinhole porosity encountered in nickel-silver castings. They found that melting under strongly oxidizing conditions to remove the carbon or deoxidizing with phosphorus or magnesium immediately before casting would eliminate the porosity.

The effects of gas absorption—pinholing, microporosity, tin sweat, cauliflower heads—are too well-known to need further justification for the considerable research effort devoted to the removal of gases from metals. The methods of practical importance at present in use may be divided broadly into two classes, oxidation treatments and gas scavenging.

Oxidation Treatments

Oxidation treatments depend on the fact that if the oxygen concentration in the melt is raised, the amount of hydrogen which the metal can retain in solution is correspondingly decreased. As early as 1925, Portevin[26] published a paper in which he showed that gas porosity in tin bronzes could be overcome by oxidizing the melt with additions of lead oxide. Since then, oxidizing treatments have been developed by a number of investigators notably Lepp[27] and Pell-Walpole[28], and there are commercial oxidizing fluxes on the market for degassing bronzes. None of these treatments is applicable to aluminium or magnesium alloys because of the neglible solubility of oxygen in these alloys and there is some doubt about their effectiveness for copper alloys containing either zinc or phosphorus since the solubility of oxygen in the melt must then be low.

Gas-scavenging Treatments

Gas-scavenging treatments are more generally applicable. Reference has already been made to the early use of volatile chlorides for this purpose and proprietary reagents containing volatile organic chlorides have been available for many years for the treatment of aluminium-alloy melts. The B.N.F.M.R.A. has been active in the development of degassing methods for both copper alloys and light alloys for some 20 years and papers on this subject have been published by Baker[29] and his colleagues. One method developed for degassing aluminium alloys using nitrogen as a scavenging gas, together with a suitably active flux cover, has found considerable industrial application. Nitrogen scavenging of bronzes has also been used at the B.N.F.M.R.A. laboratories for ten years or more and is now beginning to be used commercially.

Effects of Gas Absorption

Although the presence of large quantities of gas dissolved in a melt are definitely harmful, the practical foundryman has generally recognized that under some circumstances a small quantity of gas can help in obtaining an even dispersion of shrinkage unsoundness and aid in making pressure-tight castings. The light-alloy die-caster sometimes uses this principle in counteracting hot-tearing tendencies and lack of pressure-tightness, hydrogen being introduced into the molten metal *via* a hydrated flux. However, until some 10 to 15 years ago, very little attention had been given to this subject and quantitative data to help the foundryman in applying this technique was lacking. About this time a research was commenced at the B.N.F.M.R.A. laboratories in which attention was given to the susceptibility of different tin bronzes and gunmetals to shrinkage unsoundness and the influence of gas on the distribution of this unsoundness. Several papers arising from this research have been published[30]. The work led to the realization that some alloys absorb hydrogen not only during melting, but also while they are solidifying in the mould, through a reaction between constituents in the alloy and the steam atmosphere generated in sand moulds. This reaction is termed " metal/mould " reaction and forms the basis of a method of combating leakage caused by shrinkage porosity in tin-bronze and gunmetal castings. In this case, the reaction can be exploited to advantage, but the same type of reaction is encountered in making sand castings from magnesium alloys and

here it proved extremely troublesome in the early days. Various workers have taken out Patents covering the addition of sulphur, boric acid, ammonium bifluoride etc. to the moulding sand to prevent reaction with magnesium alloys. Aluminium/magnesium casting alloys also suffer from the same reaction and in this case research has shown that the addition of very small quantities of beryllium to the metal is effective in reducing the reaction to small proportions.

Conclusion

In this survey, no mention has been made of investigations on many subjects such as the fluidity of alloys, the effect of alloy constitution on hot-tearing tendencies and the influence of impurities in alloys, but the whole field of research is too extensive to be covered in an article of this nature. An endeavour has been made to indicate the extent of the scientific knowledge which has been gained of the foundryman's art over the past 50 years. Many questions still remain unanswered. But it is also true that much that is known has yet to be applied industrially. It is hoped that the next few years will see an intensification of the efforts being made to bridge this gap between research and the exploitation of the results in industry to the end that the foundry industry may be put on a truly scientific basis and castings may be produced which are real engineering jobs, worthy to compete with other methods of manufacture.

REFERENCES.

1 T. Turner, *J. Inst. Met.*, 1921, **24** (2), 5.
2 C. T. Heycock and Neville, *Phil. Trans.*, 1903, **202**A, 1.
3 H. Y. Hunsicker, Trans. Amer. Found. Assoc., 1947, **55**, 68.
4 W. J. Richmond, *Foundry*, 1947, **75** (10), 72.
5 R. W. Ruddle and A. L. Mincher, *J. Inst. Met.*, 1950, **78** (3), 229 also *J. Inst. Met.*, 1950, **77**, 1.
6 Assoc. of Bronze and Brass Founders, Proc. Inst. Brit. Foundrymen, 1949, Paper No. 938.
7 W. T. Pell-Walpole and V. Kondic, *J. Inst. Met.*, 1944, **70**, 275.
8 R. Genders and G. L. Bailey, British Non-Ferrous Metals Research Association, Monograph No. 3, 1934.
9 P. Brenner and W. Roth, *Z. Metallkunde*, 1940, **32** (1), 10.
10 D. E. Adams, *J. Inst. Met.*, 1949, **75** (10), 809.
11 H. C. H. Carpenter and C. E. Elam, *J. Inst. Met.*, 1918, **19** (1), 155.
12 W. Rosenhain, J. D. Grogan, T. H. Schofield, *J. Inst. Met.*, 1940, **44** (2), 305.
13 T. H. Schofield and C. E. Phillips, *J. Inst. Met.*, 1937, **60** (1), 101.
14 A. Cibula and R. W. Ruddle, *J. Inst. Met.*, 1949, **76** (4), 361.
15 A. Cibula, *J. Inst. Met.*, 1949, **76**, 321.
16 A. Sieverts and W. Krumbhaar, *Z. physik. Chemie*, 1910, **74**, 277.
17 P. Röntgen and F. Möhler, *Metallwirtschaft*, 1934, **13**, 81, 97.
18 K. Iwasé, 134th Sci. Rep. Tohuku Imp. Univer., 1916, **15** (1), 531.
19 L. L. Bircumshaw, *Phil. Mag.*, 7th series, 1926, **1**, 510.
20 P. Röntgen and H. Braun, *Metallwirtschaft*, 1932, **11**, 459.
21 P. Röntgen and F. Möhler, *Metallwirtschaft*, 1934, **13**, 81.
22 L. L. Bircumshaw, Trans. Faraday Soc., 1935, **31** (10), 1439.
23 C. E. Ransley, *J. Inst. Met.*, 1948, **74** (2), 599.
24 N. P. Allen and T. Hewitt, *J. Inst. Met.*, 1933, **51**, 257.
25 T. F. Pearson, W. A. Baker and F. C. Child, Proc. Inst. Brit. Foundrymen, 1947-8, **41**, 123A.
26 A. Portevin, Trans. Faraday Soc., 1925, **20**, 122.
27 H. Lepp, *Met. Ind.* (Lond.), 1935, **47**, 315.
28 W. T. Pell-Walpole, *J. Inst. Met.*, 1944, **70**, 127.
29 W. A. Baker and F. C. Child, *J. Inst. Met.*, 1944, **70**, 349; D. Hanson and I. G. Slater, *J. Inst. Met.*, 1931, **46**, 187; Brit. Pat. Spec 435,104, and unpublished B.N.F.M.R.A. reports.
30 W. A. Baker, F. C. Child and W. H. Glaisher, *J. Inst. Met.*, 1944, **70**, 373; W. H. Glaisher, *J. Inst. Met.*, 1949, **76** (4), 377; W. A. Baker, I.B.F. Paper No. 880, Proc. I.B.F., 1946-7, **40**, A130.

The Pattern Maker's Dog

How often do they stray away? Not for the want of proper attention, or for not having their owner's name attached; but regularly on Saturday, before leaving for the week-end, he looks after his dogs, only to find one or two of them missing. Someone has borrowed them or they have gone astray. If not found in the vicinity of the pattern shop, and well knowing the dog fanciers are in the neighbourhood, he keeps his eyes upon these gentlemen. But once they stray away they are difficult to get back again. I had a favourite dog once, that I would not part with for a trifle, but one summer during the *Dog* days, I missed my favourite. In vain I searched for it. After the lapse of a month or so, I had occasion to ramble round the Foundry, and what was my surprise to see my favourite dog, but sadly neglected and the name erased from the collar, but I had my private mark underneath. I at once claimed it, but the core maker refused to give it up, remarking "it was the best dog he ever worked, let it once get a grip and it would hold there".

The dog is very destructive to core boxes, and what is wanted is a dog that will hold securely, but not destroy the boxes. The amount of damage done is known only to the Moulder and Pattern maker. (Here was shown Sketch No. 1, showing the pattern maker's "dog".)

The Moulder's dog is a rough, rugged brute, but very strong; it is generally found lying under the bench, or stowed away in one corner, as a rule, just out of your reach.

I have found a new dog that will suit the Moulder, and will be a great saving to the employer, especially where there are a large number of cores to be made out of the one box. (Here was illustrated an improved model of a moulder's "dog".)

The dog having centres, by placing it in position on end of box or side, as convenient, and giving it a slight tap, it will mark the centre for letting in the dowels, which will be bored with centre-bit and the dowels tapped into. (Here Sketch No. 2.)

The dog must be made of steel, and the dowels of brass, which could be sold in boxes by the gross, with half a dozen dogs sent with each box, two different sizes would meet the requirements, and would be a great boon to standard patterns.—*Article by Lignum Vitae appearing in the* FOUNDRY TRADE JOURNAL, *Vol.* 2, *No.* 12, *December*, 1902.

"GREAT BRITAIN has always held the first place in the world for her castings; these will compare favourably with any other manufacturers, but the great trouble has always been to supply them to the machine-shop at such a price as will allow of her competing favourably with her competitors. This can only be done by adopting the latest and most improved methods, and by keeping abreast of the times. If foundry masters were to overhaul their foundry from time to time, and renew and improve many of their utensils, this result can be easily obtained."—*Extract from Leading Article, Jan.* 1903.

Congratulatory Messages—continued from page 38

From Mr. F. W. E. Spies, President of the *Nederlandsche Vereeniging Van Gieterij-technici*

My best congratulations with the Golden Jubilee of the FOUNDRY TRADE JOURNAL. *I only can tell you that we all like your weekly very much. I think it is the best source of information about the British foundry industry that we Dutchmen know. The fact that it is the official paper of the Institute of British Foundrymen, British Steel Founders' Association, Light Metal Founders' Association, Association of Bronze and Brass Founders, Institute of Vitreous Enamellers, Council of Ironfoundry Associations, and so on, besides the great number of advertisements and the columns for supply and demand, makes it that we are very well informed about all the questions which may arise in the domain of foundry technical science and trade in your country. The size and whole make up also make it a pleasure to study the contents of the* FOUNDRY TRADE JOURNAL. *It is a very good thing to publish varied articles of the scientific and practical side of foundrywork, market-surveys, price-quotations, and not least the reports about plants and special events. Everyone can find something that is interesting for him in every issue.*

We are grateful to know that the editorial staff of FOUNDRY TRADE JOURNAL *read our Dutch periodical* " Metalen " *thoroughly and that* " Metalen " *is interesting enough for abstracts to be taken from our reports sometimes. In conclusion, the* FOUNDRY TRADE JOURNAL *is a very welcome source of information for us and we hope you will continue along the course taken by you 50 years ago.*

From Mr. N. P. Newman, J.P., Chairman of the Council of Ironfoundry Associations

For half a century the JOURNAL *has served the foundry industry as reporter, commentator and counsellor. For the first two years of its life it was the only channel for disseminating technical information and expressing the views of the industry on questions of the day. It gave invaluable support to foundry organizations that came into being during the half-century—first the Institute of British Foundrymen* (1904), *then the British Cast Iron Research Association* (1921), *the British Foundry School* (1935) (*later to become the National Foundry College*), *and eventually the Council of Ironfoundry Associations* (1941) *and the National Foundry Craft Training Centre* (1948). *The* F.T.J., *as nearly all of us call the* JOURNAL, *has served its readers so well in so many ways. Its editorial and advertisement columns have kept us abreast of the steady stream of inventions. The news columns and its market reviews kept us in touch with events and price movements. Its small advertisements have introduced many of the younger executives to opportunities for personal advancement. For 30 of its 50 years, the policy and the personality of the* JOURNAL *have carried the impress of its present Editor, Vincent Faulkner, whose presence at national and international foundry gatherings has been unbroken for many years, and whose knowledge of everything that has been going on in the foundry world is encyclopædic. Although the* JOURNAL *is no longer the solo voice of the industry as it was 50 years ago, I, for one, turn as regularly and as expectantly to it each week as I started doing 20 years ago.*

From Mr. D. Waeles, President, *l'Association Technique de Fonderie*

The whole of the French foundry industry rejoices to learn that you are about to celebrate the fiftieth anniversary of the FOUNDRY TRADE JOURNAL. *To the numerous expressions of gratitude which you no doubt have already received I wish to add this tribute of appreciation of French foundry executives who regularly read the* JOURNAL *and derive great advantages from the articles which appear therein. Each week, and thanks to the editorial policy, the* FOUNDRY TRADE JOURNAL *carries to all countries of the world technical and scientific developments of your country. This generous mutual aid has gained for it a large international reputation and has nationally enhanced the prestige of our industry. At this time of celebration it is pleasing to recall the Editor's loyal and fruitful co-operation in all foundry congresses, and for the efforts he has put into them for advancing the technology of our interesting industry. I therefore salute him as* " *the right man in the right place.*" *The committee of the* Association Technique de Fonderie *joins me in warmly congratulating the* FOUNDRY TRADE JOURNAL *and its eminent editor on the occasion of its Golden Jubilee. In assuring you of the feelings of gratitude of the French foundry industry, they express the most sincere wishes for the increasing prosperity of the* JOURNAL *and for the fraternal collaboration of the world's foundries.*

Our First Issue

It must have been late in the month of January, 1902, when the first issue of the FOUNDRY TRADE JOURNAL was published, for the first page carries a cutting from the "Daily Express" of January 20 of that year. This cutting carried the news that Charles Schwab, the president of the American steel trust, had said the British iron industry would collapse. Thus one can presume that this would involve the founding industry.

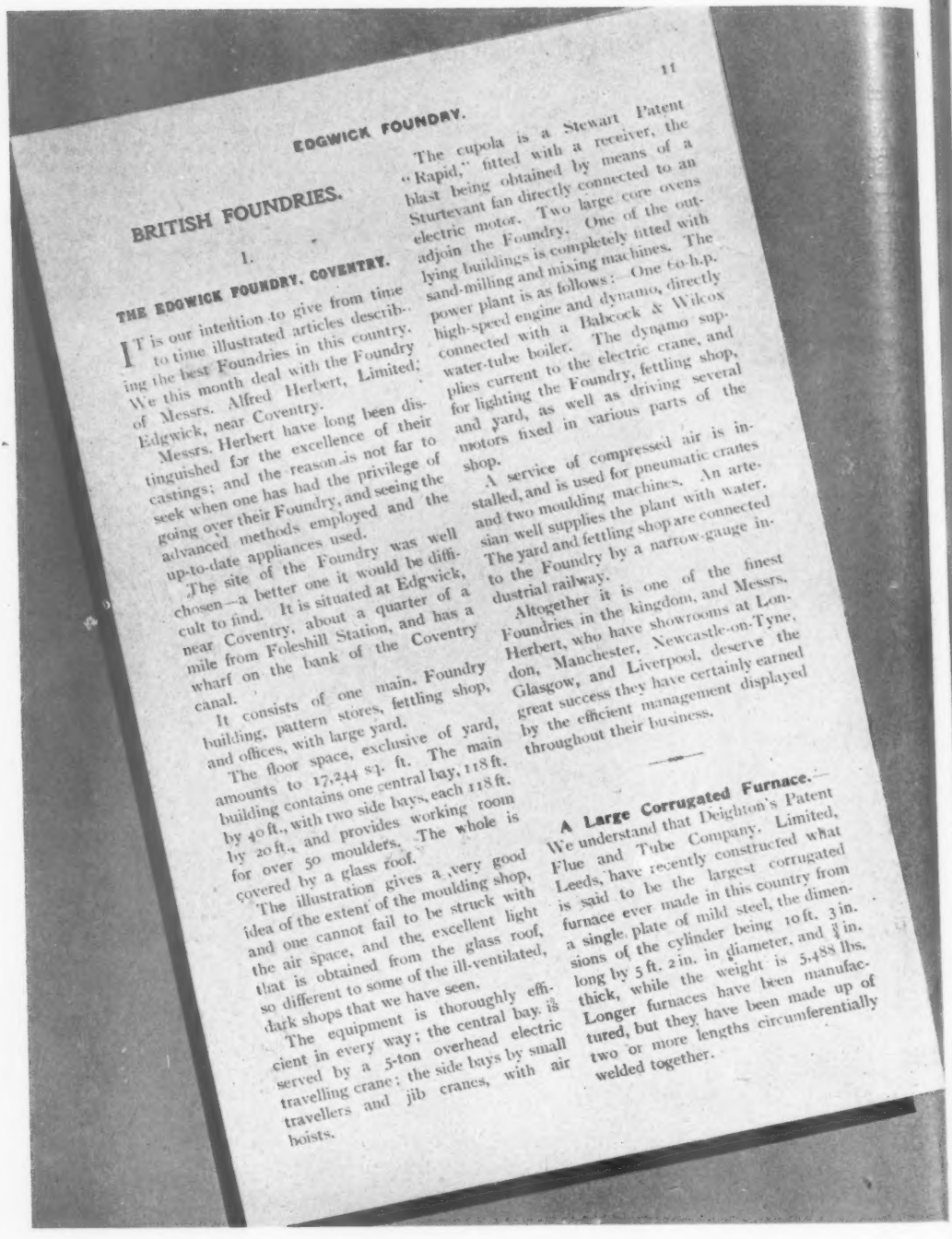
Typical of the editorial matter published in those days, Fig. 1 shows a general view of the Edgwick Foundry of Alfred Herbert, Limited (as it was fifty years ago); this foundry was described in the first issue of the JOURNAL, the actual page of text being reproduced in Fig. 2.

The average wage paid to moulders in England and Wales in 1902 was 36s. 4d. per week, the highest weekly average being in London, Liverpool, and St. Helens, at 42s. The price in Middlesbrough for No. 3 pig-iron was 44s. per ton. During 1901, the prices per ton of spelter and lead had remained fairly steady at between £19 and £17, and £16 and £11, respectively, the drop in price being due to the "general falling off of trade." Hematite pig-iron varied between 62s. and 55s. per ton; tin fluctuated between £140 and £101 10s.; copper prices opened at £74, and declined slowly during 11 months of the year to £66, when they dropped suddenly to £50. For comparison with the above, the price of a packet of 20 cigarettes in 1902 was 6d., and beer was at 2d. a pint.

The JOURNAL—then a monthly—cost 8s. a year. It carried about nine pages of advertisements, one of these being reproduced in Fig. 3.

The leading article, modestly appearing as "introduction," tells of the policy of the JOURNAL. Two paragraphs are sufficient to

FIG. 1.—*Edgwick Foundry of Alfred Herbert, Limited, in 1902; the Description is reproduced in Fig. 2.*



EDGWICK FOUNDRY. 11

BRITISH FOUNDRIES.

I.

THE EDGWICK FOUNDRY, COVENTRY.

IT is our intention to give from time to time illustrated articles describing the best Foundries in this country. We this month deal with the Foundry of Messrs. Alfred Herbert, Limited, Edgwick, near Coventry.

Messrs. Herbert have long been distinguished for the excellence of their castings; and the reason is not far to seek when one has had the privilege of going over their Foundry, and seeing the advanced methods employed and the up-to-date appliances used.

The site of the Foundry was well chosen—a better one it would be difficult to find. It is situated at Edgwick, near Coventry, about a quarter of a mile from Foleshill Station, and has a wharf on the bank of the Coventry canal.

It consists of one main Foundry building, pattern stores, fettling shop, and offices, with large yard.

The floor space, exclusive of yard, amounts to 17,244 sq. ft. The main building contains one central bay, 118 ft. by 40 ft., with two side bays, each 118 ft. by 20 ft., and provides working room for over 50 moulders. The whole is covered by a glass roof.

The illustration gives a very good idea of the extent of the moulding shop, and one cannot fail to be struck with the air space, and the excellent light that is obtained from the glass roof, so different to some of the ill-ventilated, dark shops that we have seen.

The equipment is thoroughly efficient in every way; the central bay is served by a 5-ton overhead electric travelling crane; the side bays by small travellers and jib cranes, with air hoists.

The cupola is a Stewart Patent "Rapid," fitted with a receiver, the blast being obtained by means of a Sturtevant fan directly connected to an electric motor. Two large core ovens adjoin the Foundry. One of the outlying buildings is completely fitted with sand-milling and mixing machines. The power plant is as follows: One 60-h.p. high-speed engine and dynamo, directly connected with a Babcock & Wilcox water-tube boiler. The dynamo supplies current to the electric crane, and for lighting the Foundry, fettling shop, and yard, as well as driving several motors fixed in various parts of the shop.

A service of compressed air is installed, and is used for pneumatic cranes and two moulding machines. An artesian well supplies the plant with water. The yard and fettling shop are connected to the Foundry by a narrow-gauge industrial railway.

Altogether it is one of the finest Foundries in the kingdom, and Messrs. Herbert, who have showrooms at London, Manchester, Newcastle-on-Tyne, Glasgow, and Liverpool, deserve the great success they have certainly earned by the efficient management displayed throughout their business.

A Large Corrugated Furnace.—We understand that Deighton's Patent Flue and Tube Company, Limited, Leeds, have recently constructed what is said to be the largest corrugated furnace ever made in this country from a single plate of mild steel, the dimensions of the cylinder being 10 ft. 3 in. long by 5 ft. 2 in. in diameter, and ⅞ in. thick, while the weight is 5,488 lbs. Longer furnaces have been manufactured, but they have been made up of two or more lengths circumferentially welded together.

FIG. 2.—*Text Page from the First Issue, describing the Foundry of Alfred Herbert, Limited, Coventry* (**Fig. 1**).

THE FOUNDRY TRADE JOURNAL.
CHEAPER CORES, BETTER CASTINGS.
A large number of the Leading Foundries in Europe would not be without our
CORE FORMING MACHINES
and we have received REPEAT ORDERS for three, four, and five machines.
Six Sizes, making all Cores from ½ up to 12 dia.
STRAIGHT, SMOOTH, AND EXACT TO SIZE.
J. W. & C. J. PHILLIPS,
College Hill, London, ENGLAND.
STEPHENS & CO.,
Dinas Silica Works,
KIDWELLY.
SPECIALITIES
PATENT STEEL MOULDERS' PAINT, for Clean and Smooth Surface to Steel Castings.
SPECIAL STEEL MOULDERS' COMPOSITION, for Perfectly Sound Steel Castings.
SPECIAL FOUNDRY BLACKING.
PLASTIC CUPOLA GANISTER, for Lining Iron Cupolas and Furnaces.
PLUMBAGO, Lump and Ground.
BEST DINAS SILICA BRICKS. The Best in the Market for Steel Furnaces and Converters.
FINE DINAS SILICA CEMENT, for Setting Silica Bricks.

FIG. 3.—*Advertisement Page from the First Issue. One of these Firms is still a Regular Advertiser.*

Our First Issue

indicate this. They read:

> Our Journal is instituted to illustrate and advise Foundry-masters of the best means of facilitating and improving the manufacture of castings of all descriptions. It is our main object to bring before our readers those articles of machinery, etc., that have been adopted in this and other countries, to the advantage both commercially and financially of the Trade.

This policy has been, we claim, diligently pursued throughout the last 50 yrs. The contents of that first issue included an article on "Trade Outlook" from which we learn that industry was still suffering from the "hang-over" of the South African War. A second is a very simple yet satisfactory article on the treatment of sand. Next, under the heading of "Modern Foundry Practice," there is an article extolling a British-made moulding machine invented by Mr. J. McLelland. An article on patterns tells of the use of aluminium patterns by American foundries. An oil-fired crucible furnace, of which a description is given, is quite a nice-looking job. Details of a British exhibition to be held in Russia are printed. Then, there is a tirade against free trade by Mr. Byng, then the chairman of the General Electric Company. Pneumatic tools are the subject of a short illustrated article and, not surprisingly, there is one on industrial education, wherein there is some moaning as to the dearth of intelligent apprentices, and the lack of proper training facilities in the foundry. A list of the district rates for moulders' wages is printed, showing rates which varied from £1 10s. to £2 2s. per week. Included in the issue is an abstract from the Mines and Quarries General Report for 1900; from this we learn that in that year the production of uranium ore was 41 tons valued at £1,517. Throughout the issue there is a persistent grouse of the disinclination of the industry to spend any money on foundry plant. It is almost truthful to say that it has taken the full 50 yrs. to break down this opposition.

A number of names of foundry equipment and supplies firms well known to-day appeared among the advertisers in that first issue. In cases where the title is not synonymous with present-day, the location of the firms and the nature of the wares leaves no doubt that they were modest forerunners of now-flourishing concerns.

Sands and Refractories

Fifty years ago, refractories were bought on the basis of quality and price and one received pretty much what one paid for. The highest quality of refractories in some sections were at that time often the equal of the goods offered to-day, with a possible exception on the score of dimensional accuracy.

When the 1914 war broke cut, there was the problem of replacing Austrian magnesite, and Belgian moulding sand. In the former case, attempts were made, not too successfully, towards substituting dolomite bricks. The steel foundries managed with varying success with sands of British origin, but, after the war, many returned to their earlier practice of using Belgian material. It was not long after the war that quite a controversy —still unsolved—was raging as to the respective merits of monolithic linings for cupolas as against the conventional bricked-up method.

Moulding and Core Sands

One of the most amazing developments has been in the technology of moulding and core-sand technique. First, there was during the 1914 war an investigation into British resources of moulding sands by Professor Boswell. Yet, it was the Americans who embarked on a system of ascertaining the properties of moulding sand and of standardizing the methods used. Dietert and Rees were especially prominent in this period. The techniques developed in this work have spread all over the world, yet the belief that much research of a fundamental nature still remains to be done was well indicated by Davies in his recent book. The co-operation now being given by the quarry-owners needs fostering, so that more uniformity of deliveries of sand may be assured in the future. At present, refractories for operating the "C" process of moulding and for investment casting are receiving much attention, as is the bonding of core-sands, with emphasis on synthetic resins.

An impetus was given to research on refractories by the establishment of a separate department at Sheffield University devoted to needs of this industry. The late Dr. Rees was at its head and under his direction great progress was made. He, together with the late Mr. Frank Russell, created the Refractories Association as a forum for the technicians of the industry.

The second world war again brought the question of basic refractories into the limelight, but on this occasion the refractories industry was successful in producing stabilized dolomite bricks. These, it will be remembered, were used by Renshaw in his successful experiments with the development of the basic-lined cupola.

Recent Progress

The major developments in comparatively recent times, in addition to stabilized dolomite, have been in the production of firebricks of high-alumina content; the use of insulating bricks and lagging in furnace construction; the increasing employment of carbon as a refractory; the commercial use of vermiculite and increased dimensional accuracy of standard productions.

The amount of refractory consumed for the daily patching of cupolas by the different foundries varies so widely as to make it a worth-while subject of study for managements. Not only the extra cost of the refractory, its transport and labour in applying have to be considered, but also the cost of the coke used in fusing excessive quantities as well as its removal with the slag. It cannot be said that much progress generally has been made in this particular field, although isolated cases show the enormous potentialities. In general, the half-century has seen a more scientific appreciation of the subject of refractories, and with it the realization of many benefits both economic and technical. The larger refractory concerns now have their own well-equipped laboratories both for research and production control. The British Iron and Steel Research Association has carried out much fundamental work and the physical behaviour of many complicated refractory compositions is emerging as an exact science.

50 YEARS

Consolidation of Bronze and Brass Founding

By FRANK HUDSON, F.I.M.

"I have but one lamp by which my feet are guided, and that is the lamp of experience. I know of no way of judging the future but by the past."

O. HENRY.

Few actively engaged to-day in the brass and bronze founding industry will be able to look back 50 years and clearly recall from personal experience what industrial conditions were like at that time. To find out, let us refer to Volume I of the FOUNDRY TRADE JOURNAL, for, with its publication in January, 1902, a lamp of experience was surely lit to guide us along the path of progress and enable us to judge the future by the past.

Trade Outlook in 1902

Great anxiety was being experienced, throughout the foundry and engineering industry in Britain, regarding competition from America. On page 3, Vol. I, No. 1, of the FOUNDRY TRADE JOURNAL, appears the following:—

> There is no doubt that the Americans will make strenuous efforts to increase their hold in this country, and compete with us very closely in all contracts that from time to time are to be obtained from our Colonies. This competition must be taken very seriously, and not regarded as a cycle, as it is too much the tendency to do. In nearly all branches of the engineering trade they are proving our equals, if not our superiors, in workmanship, delivery, and price.

As the year progressed, that anxiety increased and apparently business in the foundry trade was not at all good. Founders even blamed the Americans for the FOUNDRY TRADE JOURNAL, and in April, 1902 (Vol. I, No. 4), the proprietors had to publish a statement which read:—

> "It appears from communications that we have received that there is an erroneous idea afloat that our JOURNAL is another phase of the American invasion. We take this early opportunity of stating emphatically that we are distinctly British—no one but Britishers are connected with our JOURNAL, and no other but British capital is invested in it."

The only bright spot, on a dark horizon, shone on the shipbuilding industry.

> "The annual returns of the Clyde shipbuilding constitute a record for the river or any other shipbuilding centre. During the 12 months ending December, 1901, 296 vessels were launched, aggregating 530,000 tons, or nearly 40,000 tons more than in 1900, which was the previous highest year. Sixty thousand tons were represented by

Mr. Frank Hudson is in charge of the foundry section of the Development and Research Department of the Mond Nickel Company, Limited, London.

He served an apprenticeship with Sir W. G. Armstrong Whitworth & Company, Limited (now part of Vickers-Armstrongs Limited) at Elswick Works, Newcastle-upon-Tyne, in connection with the production of steel castings for armament and general-engineering purposes. At the age of 20 he was given his first executive position as melting-shop manager at the Close Works iron foundry of the above firm under Mr. Oliver Smalley. From 1925-1927 he lived in the United States and was associated with the American Brake Shoe and Foundry Company, Chicago, and other Companies.

In 1927, Mr. Hudson returned to Great Britain and became chief metallurgist with Glenfield and Kennedy, Limited, Kilmarnock. He joined the Mond Nickel Company, Limited, in 1937, to look after nickel-alloy castings production. During the second world war, Mr. Hudson's extensive technical and practical experience in this direction proved of great value to the Services and the Government.

Mr. Hudson is an active member of the Institute of British Foundrymen and the Institute of Metals, being president of the Scottish branch of the foundrymen during 1936-37, and chairman of the Scottish local section of the Institute of Metals for 1939-1944. He is an honorary associate member of the Association of Bronze and Brass Founders, as well as honorary consultant to that Association. In 1950, Mr. Hudson led a British Brassfoundry Productivity Team to the United States of America.

[*Courtesy: Phosphor Bronze Company, Limited*

FIG. 1.—*The Phosphor Bronze Company's London Foundry, in 1891. This interesting photograph has been reproduced from an article published in the "Manufacturer and Inventor" of November 20, 1891, which stated:—"It is here that the ingot metals used by brass-founders, shipbuilders, railway and other engineers, are made. Its present output is over 20 tons of ingots per week, and some five or six tons of castings in the same time. It is completely fitted in the best manner and contains the latest and every appliance necessary for the business conducted. Patternshops are provided in the galleries, and the splendidly-fitted laboratory is on the topmost floor; this last-mentioned section of the works is a "holy of holies," and under no circumstances are visitors allowed access to it, its mysteries being sacred to the metallurgical experts of the firm." [Note the absence of electricity for power and lighting.]*

warships, five of the vessels being first-class cruisers. The sailing vessels showed a marked decrease. The outlook for the ensuing year was not so encouraging."—(FOUNDRY TRADE JOURNAL, 1902, Vol. I, No. 1, January, p. 3.)

These figures are remarkable in view of the fact that the total output of ships produced on the Clyde during 1950 amounted to only 438,347 tons. Furthermore, it must not be forgotten that the ships being built at the beginning of the century were indeed fine ships. To appreciate the truth of this statement we have only to recall the old Mauretania (31,938 tons; length, 762 ft.), launched in September, 1906, with her speed of 25 knots, which enabled her to capture and hold the record for the Atlantic crossing for so many years.

In addition to the boom in shipbuilding, which utilized a large tonnage of brass and bronze castings, British brassfounders were looking forward to receiving substantial contracts in connection with work on the new electrified railway line from London to Brighton, the estimated cost of which amounted to £7,338,403.

Taking everything into account, with plentiful supplies of copper at £55, tin at £111, lead at £12, zinc at £17 10s. per ton, and moulders' wages between 28s. and 42s.* for a 54-hr. week, the brassfounder of 1902 had no apparent cause for anxiety.

Looking back over 50 years, it would indeed have been satisfying, in a review such as this, to show the growth of brass and bronze founding in Britain. That, unfortunately, is not possible, for no reliable statistics exist regarding output, and if we are to judge the future by the past, this state of affairs must be corrected without delay. How can the requirements of an industry be met, in an ever-changing world, a world of shortages, if that industry is not aware of the magnitude of its production?

Brass Foundries of 50 Years Ago

What were brass foundries like 50 years ago, and how did their equipment, methods and products compare with those of to-day? A very good idea of the answer to this question can be obtained from a study of early issues of the FOUNDRY TRADE JOURNAL, where one will find mention of such well-known names as J. Stone & Company (established in 1830), the Phosphor Bronze Company (established in 1874), the Manganese Bronze Company, Vickers, Sons & Maxim, etc., together with a surprisingly large selection of articles on such subjects as the mechanical treatment of moulding sand, liquid-fuel furnaces, pneumatic tools, core-forming machinery, foundry laboratories, moulding machines and brass-founding.

At the beginning of the present century, the best brass foundries, as will be observed from Figs. 1 and 2, were probably not unlike the average foundry of to-day. They apparently had quite good natural lighting during the hours of daylight, but artificial lighting after dark was not too satisfactory. From the tales that have been told, sanitary arrangements were definitely bad, and such amenities as canteens, air-conditioning and the heating of foundries were considered quite unnecessary. Moulds were made by hand in green-, dry-sand or loam along orthodox lines and without much use of mechanical aids apart from cranes, bogies and wheelbarrows. As a matter of fact, in 1902 moulding machines were relatively new, and it is interesting to note that the first illustrated article to appear in the FOUNDRY TRADE JOURNAL dealt with "The Tabor Moulding Machine."

* It is interesting to compare the rates of wages paid to moulders in the various districts of England and Wales during 1901. London, Liverpool and St. Helens head the list, the average weekly wage paid in these districts being 42s. per week of 54 hours; while Butterley, Exeter and Norwich were lowest, with an average weekly wage of 28s. only.

Melting

Melting was generally conducted in natural-draught coke-fired crucible furnaces, although the use of oil-fired, or what was then called liquid-fuel furnaces, were receiving consideration, following the claims made by the Brickford Burners Company, Pendarves Road, Camborne, Cornwall. (See FOUNDRY TRADE JOURNAL, 1902, Vol. 1, No. 1, Jan., p. 13):—

This apparatus has been designed primarily for the use of small foundries and repair shops, where a pot of brass may be required at very short notice, and we understand that the makers are prepared to guarantee the output of a 40-lb. pot of brass, in their smallest-size furnace, within 35 min. of applying a match to the cold furnace. These furnaces also show very pronounced economies over coke melting, especially where the conditions demand frequent single charges necessitating the special lighting of a furnace.

The following figures have been supplied to us showing the comparative costs of melting by the two systems—the figures for coke being those obtained in continuous work, and not such as would be obtained where a furnace has to be specially lighted, whilst the figures for oil are for starting all cold, so that the comparison is made under conditions as unfavourable to oil as can be:—

Comparative Cost of Coke and Oil Fusion of 40 lb. of Brass.

	Pence
Coke	
¼-cwt. of oven coke at 1s. 3d. per cwt.	3.75
Crucibles (20 charges at 5s. per crucible)	3.00
3½ per cent. waste of brass	8.40
	15.15
Oil	
¼-gallon at 2½d. per gall.	2.0
Crucibles (30 charges at 5s. per crucible)	2.0
1½ per cent. waste of brass	3.6
	7.6

Showing a saving of 7.55d. per charge of 40 lb., or over 50 per cent., to which should be added something for saving of labour.

Probably the point in this statement of most interest to-day is the indication of crucible life in 1902 as being around 20 to 30 heats when melting brass, in conjunction with a melting loss of 1½ to 3½ per cent., and the prices of coke and oil at 25s. per ton and 2½d. per gallon respectively.

Fifty years ago the use of pneumatic chisels and portable hand-grinders in the fettling shop were new developments. In fact, one particular type of hand-grinder was powered by a flexible shaft connected to a pulley driven by a belt from an overhead countershaft, which was, of course, quite in keeping with the then standard machine-shop practice of operating everything from an overhead countershaft and the view one invariably got was of nothing but belts, belts, and still more belts.

Bronze founding is the oldest branch of the foundry industry, the first bronze casting being made over 3,000 years ago, and the industry has consequently become so steeped in tradition that change of outlook or method is slow to occur. In the short span of 50 years one would, therefore, not expect any radical changes, and so far as the average brass-founder is concerned this statement is more or less true. In fact, the old foundry illustrated in Fig. 2 is undoubtedly better than many now in existence. As in all trades, there are, of course, exceptions, and it is interesting to compare Fig. 2 with Fig. 3, which shows the appearance of the same foundry to-day. Here is evidence of the real progress that results when the proper outlook is present and the right effort is made. It is to be regretted that there are not more brassfounders in Britain of similar thought and action.

Quality of Castings

Little information is available regarding the quality of brass and bronze castings produced in these old foundries and, in view of the years of excellent service such castings have been known to give, it is safe to assume that no serious problems existed in this direction. During recent years, the size and weight of castings have increased, particularly in the marine field, as will be observed from a comparison of Figs. 4 and 5. The propeller, illustrated in Fig. 5, represents probably the largest high-tensile brass casting made in Britain during the last 50 years. This casting, 21 ft. 9 in. dia., and weighing 27½ tons, is for the biggest British-built tanker to date, the single screw s.s. " World Unity " of 32,500 tons. It is interesting to record that this propeller is considerably larger than those fitted to the liner " Queen Elizabeth," which are only 18 ft. 6 in. dia., but each of which weighs about 35 tons.

Progress in Technical Knowledge and Research

During the last 50 years, a useful contribution has been made in the metallurgical field with the development of new alloys by improved methods of production and in extending our knowledge of the subject of brass- and bronze-founding as a whole. In this direction most progress has been made during the last 25 years and, in particular, since the formation of the British Non-Ferrous Metals Research Association, in 1920. The work of this Association, extending over many years, especially in connection with gases in copper and its alloys, has been of outstanding benefit to brassfounders all over the world, and has placed British technical achievements on a very high plane indeed, yet the results obtained are not being as extensively applied in practice as is warranted.

Application of Research

In the British steelfounding industry, the results of research have been effectively applied. The iron-founding industry, which closely resembles the brassfoundry industry in its structure, inasmuch as it is composed of a large number of small foundries, has also made excellent progress during recent years in connection with the practical application of

[*Courtesy: J. Stone & Company, Limited*

FIG. 2.—*Old Propeller Foundry of J. Stone & Company, Limited, Deptford, prior to* 1914. *Observe use of Loam Moulds and the more extensive use of Electricity for Power and Lighting.*

research. This has been brought about by the co-operative effort of the whole industry, through their appropriate trade and research associations, and has been financed by a levy on pig-iron. A similar system, financed by a levy on castings, is successfully employed by the foundry industries in France.

At the moment, neither the trade nor research associations connected with the British brassfounding industry are getting the financial support they deserve, and it would appear that the majority of founders appreciate the value of such associations only when others pay for them. Such conditions must be corrected without delay if the brassfoundry industry is to make real progress and maintain its proper place as a partner in the foundry industry of to-morrow.

Mention must also be made of the useful work done during the second world war by the Tin Research Institute, on improved methods for the production of chill-cast tin-bronzes and in connection with the continuous casting of bronze bar.

New and improved casting alloys, such as high-tensile aluminium-bronze, silicon-bronze, copper/lead for bearings, age-hardening alloys of the copper/beryllium and copper/tin/nickel types have been developed for industrial applications. What would the foundryman of 50 years ago have said when told that the addition of 2.0 per cent. beryllium to copper castings, followed by a simple heat-treatment operation, would make it possible to obtain a tensile strength of over 70 tons per sq. in.; or that by the substitution of 5 per cent. nickel for 5 per cent. tin in 88/10/2 gunmetal, a heat-treatable alloy is obtained capable of having its tensile properties varied at will from 20 to 35 tons per sq. in.?

Space does not permit the acknowledgment the Author would like to give, relative to the metallurgical achievements effected in the British brass- and bronze-founding industry during the last 25 yrs. This has been the work of many individuals, too numerous to mention, and apart from the valuable part such effort has played in the manufacture of sand- and chill-castings, it has, amongst other things, led to the commercial production of copper-base alloy castings by gravity die-casting and centrifugal methods, as shown in Fig 6, industrial application of the Durville process, the development of suitable welding techniques, and improved methods of inspection, using X-rays and gamma-rays.

Trade and Technical Associations

The British Standards Institution, a pattern for many similar developments throughout the civilized world, was formed in 1901, and has since provided outstanding service in bringing out standard specifications for copper-alloy ingots and castings, together with codes of procedure for inspection and analytical methods.

In 1902 there were no technical institutions looking after the interests of the foundry trade, but the

need for such an organization was obvious in view of a letter, dated London, February 6, 1902, published in the FOUNDRY TRADE JOURNAL by one who signed himself " Foundryman," and which was headed:

" An Institute of Iron, Steel and Brass Founders—Why Not ?"

The answer was given by the formation of the Institute of British Foundrymen in 1904, with Mr. Robert Buchanan as first president. In the 48 yrs. which have passed since then, the Institute of British Foundrymen, through the presentation and discussion of papers, and latterly through the work of sub-committees under the direction of the Technical Council, has played an outstanding part in promoting technical developments in the field of brassfounding. Still greater success could have been obtained if the brassfoundry industry itself had been more forthcoming in presenting its problems and achievements for discussion and record.

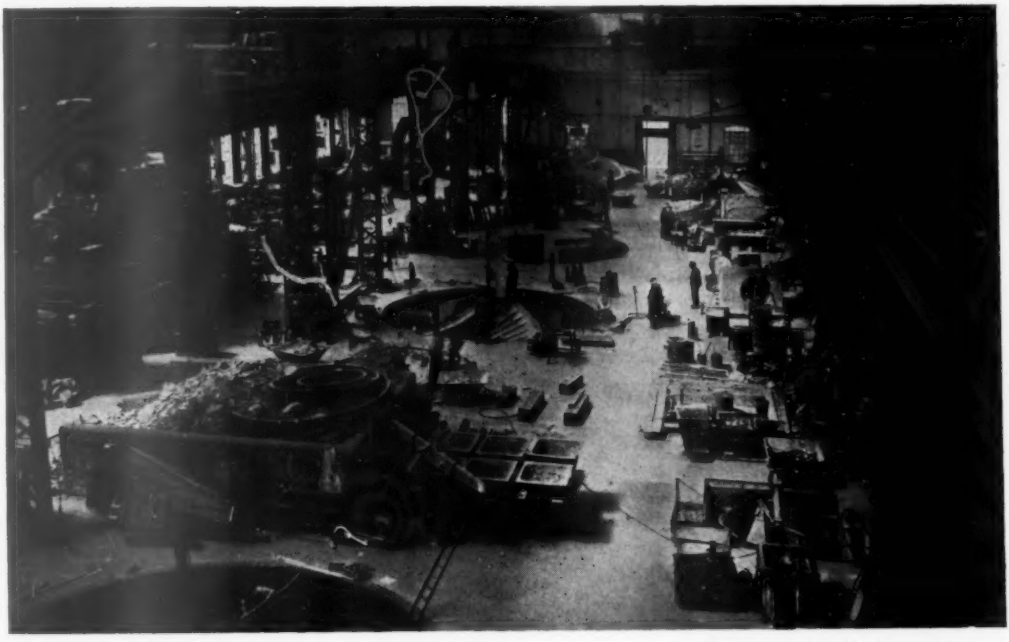
Institute of Metals

The first Autumn Meeting of the Institute of Metals took place in Birmingham on November 11 and 12, 1908, under the presidency of Sir William H. White, director of Naval Construction at the Admiralty. At this meeting, seven Papers were presented, and one by A. Philip, Admiralty chemist, entitled " Notes on Phosphor-bronze," created considerable interest. This Paper placed on record the results of chemical analyses and mechanical properties obtained on a large number of samples of phosphor-bronze, with a view to arriving at some general provisional conclusion as to the most reasonable specification for this material. Considerable information was given on the properties of cast tensile test-bars, and it is interesting to note that the results recorded for gunmetal containing 87 per cent. copper, 11 per cent. tin, 2 per cent. zinc, deoxidized with phosphorus, varied from 19.0 to 20.5 tons per sq. in. with 20 to 32 per cent. elongation on 2 in. Such results could not be bettered even to-day. Through the years, the Institute of Metals has also played a most important part in promoting technical developments in the field of brassfounding.

The development of trade associations, in succession to the earlier guilds, is a logical outcome of the growth of the trade unions, legalized from 1871. Whereas the operators were quick to get together, the independence of the masters was, as it is to-day, all against the formation of their own trade associations.

Employers' Associations

The principal brassfoundry organization in existence at the beginning of the twentieth century was the Master Brassfounders' Association formed in 1897. This body came into being as a result of the amalgamation of a number of loosely-formed committees, the Gas and Chandelier Makers, the Plumbers' Brassfounders, the Brass Casters, and the



[Courtesy: J. Stone & Company, Limited

FIG. 3.—*Propeller Foundry of J. Stone & Company, Limited, Charlton, as it is to-day. The Randupson Process, employing Cement Moulds, has superseded the use of Loam Moulds.*

[Courtesy: J. Stone & Company, Limited

FIG. 4.—*High-tensile Brass Propeller Castings leaving the Deptford Works of J. Stone & Company, Limited, in about the year* 1914.

Cabinet Brassfounders being notable examples. It is strange to recall that the Master Brassfounders' Association owes its inception to the late W. J. Davis, that character of the Victorian and Edwardian trade-union world. Weary of having so many and such conflicting organizations to deal with, he begged them to form one body, which, eventually, they did. Much could be written about Davis, and much has been, but he is probably the only trade-union official to father a masters' organization. In 1906 the name was changed to the Brass Masters' Association, in 1921 to the Brassfounders' Employers' Association, and in 1944 to the National Brassfoundry Association.

Until the formation of the Association of Bronze and Brass Founders in October, 1942, there was no trade association in Britain representing founders producing brass and bronze castings required in the field of engineering, such as marine propellers, centrifugal-pump impellers and casings, valve-bodies, etc. The Association of Bronze and Brass Founders was primarily formed to represent the manufacturers of such castings in discussions with the Ministry of Fuel and Power on the subject of fuel economy which arose during the second world war, and since then it has given valuable service in connection with negotiations with the Ministry of Supply, to ensure an adequate supply of raw materials and other matters of major importance to the industry as a whole. Furthermore, the Association has appointed a competent Technical Committee to advise members on their individual problems and to deal with technical matters of importance to the industry. In this latter direction, a number of valuable reports have been issued, such as "Properties of Copper-base Alloy Castings," "Operation of Metal-melting Furnaces," "Metal Losses in the Foundry," etc.

Productivity

In April, 1950, the National Brassfoundry Association and the Association of Bronze and Brass Founders sponsored a team, representing the British brass foundry as a whole, to investigate productivity in the United States. Their Report, published last year, has been most favourably received, and will undoubtedly play an important part in promoting efficiency and increased productivity, provided that real co-operation is forthcoming from everyone in the British brassfoundry industry. In looking through the early editions of the FOUNDRY TRADE JOURNAL one comes across a reference to another productivity report, in the form of a book entitled "The American Workman: His Secrets of Efficiency and Success," published in 1902 by a Frenchman named Levasseur. The review of that book makes interesting reading, particularly the following extract:—

> "Mr. Levasseur was much impressed by the orderliness and excellence of the conditions of work. In many works he found baths and toilet rooms for the men. In one there was a locker for each man in which to keep his outdoor clothes while working, and the inserting of the key in the lock of a machine automatically registered the hour of the man's arrival. Mr. Levasseur set himself to find if the American toiler really lives better than others. He found that he does. He lives, dresses, and indulges in luxuries which surprised the French critic. It is very common in the west, and not rare in the east, Mr. Levasseur states, for workmen to keep their own carriages."

The importance of trade associations cannot be too highly stressed, for only by such co-operative effort can an industry become really efficient within itself and properly organized to represent and help the individual and the nation as a whole. The value of trade associations is aptly summarized in a recent editorial in the American publication *Modern Industry* (October, 1951), where it is stated:—

> "Deepening interdependence appears to characterize the relationships between large and small manufacturers. A reason for this is the increasing complexity of technology required to design and process modern products. In an era of synthetics and supersonic speeds, it is a sizeable company indeed that can depend safely on its own research budget and brains to keep abreast

Most companies, especially the little fellows, must go outside their organizations to get the scientific substance they need to compete."

In the past, the trade associations representing the British brassfoundry industry have not been properly supported and, unless such a state of affairs is altered, how can there be any hope for real progress in the future.

Labour Relations

What was happening amongst the unions at the beginning of this century? There were conflicting interests at work in the foundry industry, as is apparent from the following extract taken from the FOUNDRY TRADE JOURNAL (1902, Vol. I, No. 2, February, p. 62).

"It is regrettable that the Iron Founders' Society and the Brass Founders' Society cannot come to some amicable arrangement and definitely settle the long-standing grievance of the right to work in one another's departments. The Associated Iron Moulders of Scotland and the Friendly Society of Iron Founders of England, Ireland and Wales have offered to combine the two sections together, so that it would allow an iron and brass moulder to work side by side in harmony. This offer has not been accepted. The brassfounders seem to be under the impression that, were this combination to take place, they would be gradually ousted out of the foundries altogether. In fact, they try to enforce their version of the law so emphatically that they try to prevent any but brass moulders working in the brassfoundry. In one case, a number of brass moulders struck work because the foreman happened to belong to the other Society. Many foundries, such as the Phosphor Bronze Company and the Manganese Bronze Company, employ mostly members of the Iron Founders' Society, and their example is being rapidly copied by many other large brass and bronze foundries."

Epilogue

Looking back at the brass- and bronze-founding industry, one is impressed by its consolidation and growth, but it appears, with few exceptions, that many foundries to-day are still modelled on the same lines as those of 50 years ago. There is plenty of scope for improvement, particularly as regards the use of properly-planned layouts, in conjunction with the more general use of simple mechanical aids in order to increase production. Every aspect of this subject is fully covered in the British productivity team's Report on "The Brassfoundry," published last year, and this should provide a useful basis for developments in the years to come.

In comparison with other branches of the foundry industry, the brassfounder of the past has been slow to apply the results of research and take full advantage of modern developments. Proud tradition is of little national benefit to-day, unless it is also associated with a co-operative and properly-organized effort to operate foundries more efficiently and produce a better casting than ever did our forefathers. There is little evidence of this during the past 50 years, but let it be our hope for the future.

[Courtesy: J. Stone & Company, Limited

FIG. 5.—*Cast High-tensile Brass Propeller fitted to s.s. "World Unity" in November, 1951. This is probably the largest brass casting produced in Britain over the last 50 yrs., being 21 ft. 9 in. dia. and 27¼ tons in weight.*

[Courtesy: Phosphor Bronze Company, Limited

FIG. 6.—*Modern Foundry producing Centrifugal Castings.*

International Technical Co-operation

There is some gossip that there was an international conference held in Belgium prior to 1920, but co-operation was really initiated in 1921, when through the efforts of the late Mr. Oliver Stubbs and the late Mr. Tom Firth—both past-presidents of the Institute of British Foundrymen—after a visit to the States was inaugurated a system of exchange papers with the American Foundrymen's Association. The first Paper was read at the Blackpool Conference; it was written by Mr. Elliot and dealt with the use of the electric furnace in the foundry. From that year onwards there has been annually an unbroken series of high-class papers which have materially enriched the proceedings of both associations. In 1922, during a convention held in Birmingham, there was a handful of visitors from America, France and Belgium, and at a private dinner given in their honour there was mooted the idea of international technical collaboration. However, nothing was achieved until early in 1927, when the late Mr. Paul Ropsy invited the various European technical associations to meet him in Brussels to explore the possibilities. Only four nations were represented—Belgium, France, Germany and this country. The United States joined in the work of the International Committee of Foundry Technical Associations on its formation very soon afterwards. The British delegates were Mr. V. C. Faulkner (president of the Institute) and Mr. T. Makemson (its newly appointed secretary). Makemson was elected honorary secretary, a position he still holds.

Rota Established

Early on, there was much discussion as to the rota for foundry exhibitions, as it can be presumed there was much competition for the holding of international conventions plus equipment exhibitions. Order was established, and a proper rota was created which lasted until 1939. An amazing outcome of this activity was growth of foundry technical organizations throughout Europe. It was, of course, without direct significance elsewhere until very recently. Very quickly, associations were created in Italy, Spain, Holland, Czechoslovakia and Poland. Since 1945, membership has been accorded to Norway, Sweden, Denmark, Switzerland and India. This collaboration and its method of practical expression is, it is thought, unique in technical circles.

During the 25 years of its existence, meetings have been held in Belgium, Czechoslovakia, France, Germany, Holland, Italy, Poland, Spain, the United States and this country, many visited more than once. The character of these gatherings has changed during this time. The social aspect has been developed, yet kept in its proper perspective. It is the technical aspect where the greatest progress has been made. The British delegates in the early days preferred sightseeing to attendance at lectures where, owing to language difficulties, they understood but little. Nowadays, those " difficulties " have been overcome by sound organization, and especially during the last two meetings in Holland and Belgium the English-French language cocktail became an acceptable beverage. *Experientia docet* and as each European national manifestation has had the benefit of Mr. Makemson's wide experience, an organization of high merit has been created of which the foundry industries can well be proud.

Reminiscences

Yet obviously and desirably each nation imposes upon the congresses the imprint of its own culture. Each conference has registered its own mark on the history of the Association. In Poland, quite a few of the delegates suffered inundation through the overturning of a raft. In Italy, there was a breath-taking expedition on an aerial ropeway. In Holland, a unique historical dress show. From Barcelona there are memories of what must surely be the most fantastic architecture in the world and noisiest of children. In Paris, at one banquet every male British delegate was knighted, except the commercial attaché, and being a genuine knight, he reverted to plain " mister." In Germany, there was a luncheon called for midday which failed to materialize until after 3 o'clock, Dr. Schacht was late! Then that evening there was dinner of an informal character when one pleasing folk song started with the guests sitting, then standing, then a foot on their chairs, and finally on the table. An exhibition which was perhaps the best ever held in Europe was when in Prague the president (Mr. Gesteranus from Holland) made the same " thank-you " speech in a minimum of ten languages without a note! A marvellous feat of memory. In Belgium, which has been visited on a number of occasions, an outstanding memory is of a Lucullan banquet in a room with a sliding roof——and so one could go on.

The result has been that there has been created amongst the foundrymen of the world a truly friendly feeling, which is so useful in facilitating international business and technology.

The following are extracted from the leading article of December 29, 1921:—

" An important event which has taken place during 1921 is the granting by the Privy Council of a Royal Charter to the Institute of British Foundrymen, which, additionally to materially adding to the status of the Institute, widens its scope, for its reception allows of its development in any direction, except those specifically prohibited by the wording of the Charter."

" The year 1921 has seen the foundation laid for an international foundry exhibition, to be held in June next year at Birmingham, under the joint auspices of the Birmingham Chamber of Commerce, the British Cast Iron Research Association, and the Institute of British Foundrymen. This will be the first time in the history of the British foundry trade that such an attempt has been made."

50 YEARS

Pipe-dreams to Practice through Cast Iron Research

By Dr. J. G. PEARCE, O.B.E., M.I.Mech.E., F.I.M.

Although cast iron was known and used before the Industrial Revolution, that great historical event created both the demand for cast iron on a considerable scale and the means for satisfying through the provision of power following the advent of the steam engine. The material was destined for a century or more to supplant stone and timber as the leading engineering material, until the Bessemer process and subsequent developments brought about the large-scale production of steel. The gradual adoption of steel (more gradual than many suppose if one recalls that the Eiffel Tower in Paris, built in 1878, is made of wrought iron) and the introduction of a variety of other materials, is doubtless responsible for the idea that cast iron is on its way out. Like Charles II, it is "an unconscionable time dying." On the contrary, its annual output has steadily increased over the past few years to record heights. This is due in part to the general expansion of industry, but not least to an increasing recognition by engineers of the value of obtaining a piece embodying varied sections by a single industrial process. The extent to which this is due to research, giving increased control, leading to better and more uniform properties, points the way to an increasing share of the available market by the wider use of technical control, the employment of technically-trained young men and a still more vigorous research programme.

In its beginnings, founding was wholly an art, developed by individual ingenuity and skill, almost entirely on a basis of trial and error. The results, it is feared, were only partially passed on to others, so that much unrecorded experience must have been lost. That this situation has extended into comparatively recent times is well illustrated by uncertainty, for example, as to the origin of the oil-bonded core. British, and particularly Scottish, founders played a notable part in the development of the art and have exercised their skill and influenced the growth of the industry in many countries all over the world. It is doubtful whether adequate justice has ever been done in written records to the part of the founder in making the Industrial Revolution possible; for example, John Wilkinson's boring lathe and his foundry skill made Watt's engine cyinders a practical possibility. Science therefore

Dr. J. G. Pearce, O.B.E., M. I. Mech. E., F. I. M., widely known at home and abroad for his long years of brilliant service in the field of cast iron research, graduated at the University of Birmingham and after an engineering apprenticeship, including foundrywork, he spent several years in industry on the organization of industrial research and education. In 1924, he was appointed director of the British Cast Iron Research Association, and its development has since been his major interest. He is a double gold-medallist of the Institute of British Foundrymen and a member of Council.

In 1948 he received the honorary doctorate of the University of Aachen and in 1950 he was created an officer of the Order of the British Empire. Dr. Pearce inspired the establishment in 1935 of the British Foundry School, restarted at Wolverhampton after the war as the National Foundry College, He is a member of the Livery of the Worshipful Company of Founders and a Freeman of the City of London. Under his direction, the British Cast Iron Research Association has in recent years grown spectacularly, both at the headquarters, Bordesley Hall, Alvechurch, and at the Scottish laboratory, near Glasgow.

came late to the foundry, for founders themselves were primarily craftsmen. It was inevitable that the first steps were taken by men themselves skilled in the art. The technical aspects of composition, melting practice, melting losses, shrinkage and contraction, tests and test-procedures, and later sands and sand-control, arose initially through their interest and curiosity. By the time the FOUNDRY TRADE JOURNAL was founded and the Institute of British Foundrymen was born, the future rôle of science was accepted and for the next quarter of a century the application of science began to grow. It is of interest to recall that Turner, whose work on silicon effects (published in 1885) was a great step in modern foundry metallurgy, had access neither to the technique of microscopic examination nor high-temperature measurement, for only about that time did Sorby take up again his early work on microscopic examination and the thermo-electric pyrometer evolve.

At the beginning of the twentieth century, however, where this review commences, the microscopic study of metals had become a metallurgical tool, methods of analysis for the commonly-occuring elements in cast iron had been evolved and the idea of a eutectic was just emerging; the significance of the phase rule was on the threshold of metallurgical understanding. In rapid succession, developments took place which have barely yet touched the iron foundry, although they have materially modified other branches of metallurgy: X-ray diffraction, radiography, precipitation hardening, the conception of creep, lattice structures, and the electronic structure of alloys, quantitative spectroscopic analysis, the electron microscope. It is impossible in a brief review to mention the names of all those whose work has signposted this march of metallurgical progress.

Raw Materials

The major raw materials used by the industry are pig-iron, coke, moulding- and core-sands, and refractory materials. Reference is made to the last three mentioned elsewhere. While a good range of foundry pig-irons is available to founders in this country, the considerable disturbances due to the war have interfered with the characteristic compositions formerly associated with pig-irons from particular regions. This, together with the marked tendency to machine-cast pig-iron, has compelled the founder to rely more on analysis and less on fracture, although faith in the ability of fracture to reveal something of melting characteristics has not wholly departed. The development of refined pig-irons by a variety of processes has placed at the disposal of founders, pig-irons to very close compositional tolerances, and this development appears to be peculiar to this country. It cannot be said that metallurgical coke is as satisfactory as it used to be and there is little doubt that difficulties with respect to natural resources available are in part responsible. The industry to-day purchases a much wider range of naturally-occurring and semi-manufactured products than ever before as its work becomes more and more technical, and is an increasing market for instruments, plant and equipment through the aid of which its manufacturing programme may be conducted.

Improvements in Cast Iron

Reverting to the early years of the century, understanding of the metallurgy of cast iron was imperfect and reputations were built more upon experience and on the use of uniform raw materials of good quality. The bulk of engineering castings had a strength of the order of about 8 to 10 tons per sq. in. and even up to the first world war, figures of the order of 15 tons per sq. in. were unusual. Between the wars, developments ensued which made it possible to call for 26-ton tensile cast iron in a national specification, in the regular pearlitic structure of machinable engineering cast irons. In addition to that, a number of other structures were produced, serving particular purposes, so that it is possible to-day to produce not only ferritic and/or pearlitic cast irons, but cementitic, austenitic, martensitic and acicular irons.

Lines of Approach

Four lines of development were pursued. First, the reduction of carbon content brought about a stronger iron by reducing the total quantity of graphite and the size of the individual flakes, mainly accomplished in practice by the use of a proportion of steel scrap in the cupola charge. This process found its logical end in the German process which was understood (precise details have never been published) to use a charge wholly of steel scrap and ferro-alloys, the iron having relatively low carbon and high silicon. On the other hand, the hot-mould process, by using the delayed cooling of a heated mould, was able to use a silicon content so low that the metal under normal conditions would have been white. This process is still occasionally used. Ordinary cast iron tends to be roughly eutectic in composition, and under ordinary cupola melting conditions, will reach this after several melts, whether the carbon starts above or below the eutectic. Engineering irons, with a flake-graphite structure and a pearlitic matrix, have a strength which, within limits, rises as the carbon falls, and subject to design and castability, this way of achieving strength has persisted until to-day, although in the new nodular irons carbon content is of less importance from this point of view. An important feature in all these developments is control of composition, not only of carbon but also of other elements. The second line followed—the risk of producing white iron, or alternatively of undercooled graphite, in making these rather-hard irons is offset by the process of inoculation, that is, a late addition of silicon to the ladle prior to pouring. While a variety of materials is used, the name of Meehan is particularly associated with the use of calcium silicide for this purpose. The third step was to strengthen the matrix by the use of alloy additions—copper, nickel, chromium, molybdenum—either singly or in appropriate combinations, and advantage was taken of the natural occurrence in certain pig-irons of titanium and vanadium.

Fourthly, in special cases, the heat-treatment methods evolved so successfully for the steels were applied to cast irons.

Alloy and Special Irons

Limited alloy additions of the kind referred to do not cause a marked structural change, but by appropriate extensions, structural changes were produced, so as to create the austenitic, martensitic and acicular irons. Ni-Resist, Nicrosilal and Nomag are used for their corrosion-resisting, heat-resisting and non-magnetic properties. They are all structurally austenitic. Ni-hard is an alloyed martensitic iron, used for resistance to wear, erosion or abrasion, and the acicular irons are hard but machinable engineering irons of high strength, characterized by the presence of molybdenum. The high-chromium (30 per cent.) irons proved to be the most resistant to combined effects of heat and corrosion, especially in the presence of sulphurous gases.

White or cementitic irons have only limited application, but are of great technical importance. They have shared in the general improvement due to better methods of testing and control, as have the malleable cast irons. Whiteheart malleable is normally a pearlitic base material and blackheart a ferritic base, with physical properties corresponding to these structures; in thin sections, whiteheart can be entirely ferritic, while a fully-pearlitic blackheart is also made, as is blackheart with a pearlitic rim, known as "picture-frame." The major development in this field has been the evolution of gaseous annealing, which has revolutionized the old process of ore-packing, and improved shop conditions. The high-silicon, acid-resisting irons were well known at the opening of the century, but some studies of growth at the British Cast Iron Research Association showed that silicon was not, as had been previously believed, the cause, but the graphite coarsening which accompanies increased silicon. This enabled a silicon iron with 4 to 6 per cent. silicon, known as Silal, to be evolved. A series of aluminium irons was also worked out to confer heat-resistance, but their further development has not been pursued since the war.

In the field of light castings and castings for the civil engineer, the change has been rather in design and form, and in finish, rather than in the character of the metal itself, although these branches have fully participated in improved control and manufacture.

Processes which affect the structure of the metal and which have established themselves as an integral part of the industry are centrifugal casting (with which the names of Mr. P. H. Wilson and Dr. J. E. Hurst have been closely associated in this country) and die-casting—the continuous production of suitable iron castings in dies. They are of great importance, and a considerable tonnage of centrifugal pipe is exported.

Nodular Irons

The most striking achievement of the century in this field, by general consent, is the development of practical and realizable processes for the

FIG. 1.—*General View of Bordesley Hall, the British Cast Iron Research Association's Headquarters at Alvechurch. Many Additional Laboratories have now been Erected.*

production of nodular cast iron in the as-cast state, yielding strengths several times that of ordinary cast iron and characterized in addition by a measure of ductility and considerable shock-resistance. Comparison between the nodular irons and ordinary grey irons is difficult, for several reasons. In the first place, the composition differs for similar basic structures in the respective cases. Furthermore, nodular graphite can be produced with any matrix structure—pearlitic, ferritic, austenitic, martensitic, acicular—and like must, of course, be compared with like. The cerium process was announced by the British Cast Iron Research Association in 1948, followed quickly by the magnesium process by the International Nickel Company in United States and the Mond Nickel Company, Limited, in this country. This work created enormous interest in industrial countries and the amount of published work already runs into several hundred items, although only a proportion of this represents experimental enquiry. There is, however, little doubt that this development is destined to play an enormous part in the future of cast iron and its metallurgical development.

In 1900, there was no sand-control as we know it to-day, very little synthetic sand, and drying oils were only just coming into general use as binders, although cores were bonded with flour, wood-resin and other organic materials. There were occasional articles in the technical Press, which put forward suggestions such as the need for sand-control and the use of synthetic sands, which have proved to be remarkably accurate anticipations of present-day practice, but these do not appear to have been followed up at the time.

Early Knowledge

Interest in the subject of foundry sands was greatly stimulated during the period 1914 to 1918, partly owing to the cutting-off of supplies from Belgium and France, and in 1918 Professor Boswell published his memoir on British sources of supply. This was not only the first systematic survey of available deposits, but also the first attempt to determine the quality of a sand by means of an accurate mechanical analysis. From that time, progress was more rapid and the importance of the testing and control of both raw sands and foundry mixtures was widely recognized. Early in its existence, the B.C.I.R.A. appointed a committee to supervise work on the subject and has published about fifty Research Reports. The number of foundries conducting research for themselves also increased rapidly, although some time elapsed before the results could be seen in improvements in practice. The adoption, in the period 1924 to 1926, of methods of measuring the physical properties of sand-compacts was the essential step which permitted real progress to be made.

From about 1930, the application of the results increased, and synthetic-sand and closely-controlled oil-sand mixtures came into greater use. The rapid growth in machine moulding, and particularly in the number of fully-mechanized units in operation, made necessary the use of continuous supplies of uniform sand, which in turn required standardization of testing methods. At the present time, the standard methods of testing, based mainly on those originally published by the A.F.A. nearly thirty years ago, are in use in most industrial countries.

Mould Materials

For the most part, there were few changes in the raw materials used. The use of drying-oils was fully established early in the period and, except for the introduction of a uniform type of cereal binder, attention was mainly centred on making the best use of available materials. Synthetic sands were bonded either with high dry-strength bentonite or a medium dry-strength ball clay. The difficulties in obtaining certain raw materials during the war increased interest in the use of alternative materials, and the high price of some imports, notably linseed oil, has maintained this interest. At the present time, a whole range of clays by means of which green- and dry-strength can be varied over a wide range, is available and more precise control over synthetic sands has become possible. The most interesting development so far as organic materials are concerned has been in the use of synthetic resins, produced entirely in this country, and these have replaced imported linseed oil in a number of coreshops. Their use has also made possible the development of the "C" or shell-moulding process, in which a bulky sand mould is replaced by a thin shell. In suitable cases, this method may help in the solution of both sand-handling and dust problems, and facilitate mechanical handling.

Except for minor modifications, sand-testing methods have changed little in the past twenty-five years. A few new tests, used mainly to fill-in gaps existing in the earlier methods, have been developed, but there has been little testing of sand at elevated temperatures, at which it is used, mainly because with conventional methods of heating, the organic materials widely used in ironfoundry green-sands are burned-out before the test can be made. The rapid heating possible by electronic methods offers a means of a new advance in this direction.

Melting Practice

For the whole of the period under review, the cupola furnace has been almost universally used for the melting of cast iron in industrial conditions. There has been little apparent change in the external form of the cupola furnace, but many developments in respect of detailed aspects of design and operation have been made, with the result that much more can now be done in the way of designing a cupola incorporating all the features which will give the most satisfactory results for a given set of foundry requirements, while our better understanding of the cupola processes means, for instance, that a new furnace may be put into operation, and the required results obtained with a high degree of certainty from the outset. In spite of this, the cupola, while being the most economical melting unit, remains very flexible in operation and can normally be adapted to meet fluctuations or changes in working conditions without great difficulty.

The inside of the cupola lining remains normally cylindrical in shape. There was a trend, due in many cases to the use of short cupolas giving inadequate heat recuperation in the furnace shaft, towards linings tapering outwards above the melting zone. While in many cases such a lining shape may usefully be retained, the trend appears to have been arrested, or even reversed, mainly from the points of view of good distribution and smooth descent of the charge-materials and of minimizing lining erosion. The work of Rambush and Taylor was noteworthy in throwing further light on the subject of charge distribution.

Air Supply

Voluminous literature has appeared over the period on the subject of the size, shape and distribution of cupola tuyeres. From this very fact alone it may fairly safely be assumed that variations in size and shape of tuyeres, over a reasonably wide range, has a very small effect on cupola operation compared with other factors such as the volume or weight of air supplied through the tuyeres. Jungbluth has indicated the general relationship between air supply, charge-coke consumption, metal temperature and melting rate, and has also put forward mathematical rules governing cupola operation. A number of cupola designs incorporating multiple rows of tuyeres has been put forward, the primary intention in most cases being to reduce coke consumption by improving combustion efficiency. The balanced-blast cupola, developed by Fletcher, is the most notable example of this type. Many of these cupolas have been installed, in most of the industrial countries of the world, with excellent operating results, but it may, perhaps, now be open to some doubt whether their success has been due to the actual tuyere arrangement employed, or to the close attention which has been paid to other important features of good cupola design, such as optimum relationship between size and required capacity, height of charging door, distribution of air between the tuyeres in any one row, and also to the close co-operation between designers, founders and cupola manufacturers in the case of each installation. Good distribution of the air between all the tuyeres is now regarded as very important, to the extent that, in certain cases, the air passing to each tuyere is actually measured.

Questions relating to the quality of cupola coke have received much attention and, particularly during recent years, it would appear that coke has suffered from an overall deterioration in quality. Some economically inefficient coke-ovens which, nevertheless, produced high-quality coke, have closed down, and such factors, together with an increasing long-term shortage of good coking coals, hold out no great hopes for a very marked improvement in the situation. Of technical developments aimed at enabling foundries to produce high-quality molten iron with the minimum quantity of coke, the quality of which need not necessarily be the highest, the most interesting would certainly appear to be the use of preheated blast in the cupola.

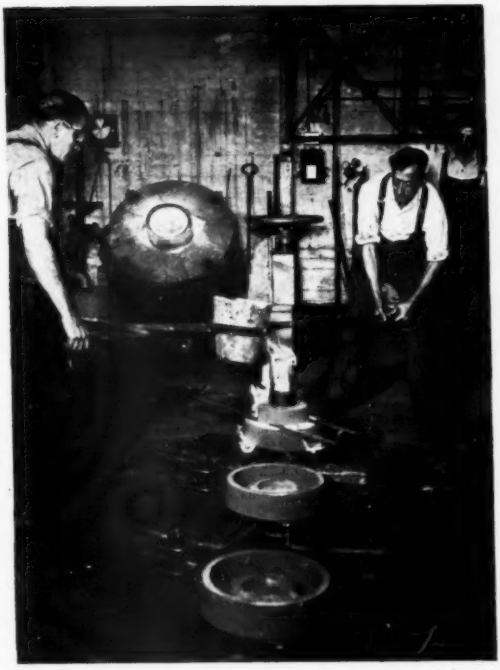


FIG. 2.—*Corner of the Experimental Melting shop at Headquarters showing the Pourings of Spiral-mould Test-pieces.*

Hot Blast and Special Linings

Numerous designs for hot-blast cupolas have been put forward over a period of many years, but most of these have utilized some sensible heat, normally lost from the conventional cold-blast furnace, for heating the air. The first system adopted on a fairly wide scale, using the latent heat of the cupola waste gases for blast pre-heating, appears to be that developed by Vial and known as the Griffin system, from the original Schurmann design. The blast temperature employed was 200 to 300 deg. C. Later, Piwowarsky demonstrated the advantages of using blast preheated to over 400 deg. C., and during the last few years there has been very great interest in the design and installation of hot-blast plants employing such air temperatures. Although most interest attaches to the recuperative type of plant, of relatively high capital cost, it has been shown that a system involving heating the air with an external fuel can be economically justifiable under some conditions. Although the enrichment of the normal cupola blast with a few per cent. of oxygen has been shown to have similar effects to hot blast, continuous enrichment has not yet, apparently, been adopted as a commercial proposition.

There has also been increasing interest in cupola

linings, permitting the use of a more-basic slag, in an attempt to produce iron having low-sulphur and high-carbon contents, but development of this appears to have been retarded by difficulties of supply and high cost of suitable materials. A notable development aimed at reducing the material and labour costs of repairing cupola linings, and obtaining the advantages accruing from a constant lining contour, is the insertion of water-cooled panels in the lining, as described by Bamford and Renshaw.

On the question of instrumentation, whereas in the early years of the century the most that a cupola installation would be likely to possess was a pressure gauge and a clock, many more installations now include a blast-volume indicator or recorder, while automatic constant-air-control, either by weight or by volume, is being increasingly employed. A number of additional instruments are required for hot-blast operation, the same applying to oxygen enrichment, water-cooling, humidity control, and so on, so that the control panel for the modern cupola installation is on the verge of becoming an impressive affair indeed.

The period under review covers the development of rotary oil- and pulverized-fuel furnaces, and electric-arc and induction furnaces for the melting of cast irons, and these, together with air furnaces and crucible furnaces, are normally employed for melting (*a*) small quantities; (*b*) metal compositions which cannot be obtained from the cupola; (*c*) special irons containing costly elements; and (*d*) iron from charges such as borings, which may not conveniently be melted in the cupola.

Methods of Testing

Considerable growth has taken place in the use of methods of testing for the control of foundry raw materials, of their processing, and of the finished product. The principal channels are microscopic examination, chemical analysis, mechanical testing, and, more recently, spectroscopic analysis. While direct foundry tests are used to some extent (such as for assessing fluidity) the principal ones in use are chill-tests, which relate to the nature of the work being done. This varies so widely, and chill depends on so many factors, that the tests have not been standardized, although there are general similarities between, say, such control tests for malleable and for chilled rolls, and yet marked differences between the two types.

Microscopic examination is used widely, and there is no comparison between the crude photomicrographs of 50 yrs. ago and the results obtained with modern techniques of polishing, etching and photography. The polishing techniques which reveal the actual graphite may be well seen in the book of photomicrographs issued a month or so ago by the B.C.I.R.A. entitled "Typical Microstructures of Cast Iron."

The development of chemical analysis has resulted in the progressive simplification of the methods used and an increasing use of instruments based on physical principles. The chemical methods used 50 yrs. ago for the analysis of cast iron were generally lengthy, involving difficult separations which called for a high degree of skill and years of training on the part of the chemist. By the introduction of new reagents and techniques it has been possible to develop methods by means of which analyses can be obtained more rapidly and with a higher degree of accuracy. Typical of this is the use of perchloric acid for the determination of silicon.

Another development from 1911 onwards was the application of specific organic reagents to metallurgical analysis. Beginning with the use of dimethylglyoxime in the determination of nickel, a very large number of these reagents has been introduced—cupferron, α benzoin monoxime, and 8-hydroxyquinoline being particularly useful.

The greatly increased use of alloy additions referred to earlier has necessitated a much larger number of analytical methods, and this has more than offset the simplification mentioned. The recently-published work by Westwood and Mayer gives analytical methods for no fewer than 25 elements which may occur in pig and cast iron, the commonest being, apart from those usually present, copper, nickel, chromium, molybdenum and titanium. Nodular irons have introduced new analytical demands, and the mercury-cathode and other separation methods are useful for small amounts of elements such as aluminium, magnesium, calcium.

Colorimetric methods, many of them employing organic reagents, have found increasing use, particularly since the introduction of the Spekker photoelectric absorptiometer. The large dispersion quartz spectrograph has been used very successfully for the spectrographic analysis of ferrous materials, particularly for rapid routine control work. The most recent development of direct-reading spectrographs, which eliminate the photographic routine, is giving increased speed and accuracy in this field.

In addition to the improvements brought about by these techniques, in the determination of the usual elements in ferrous materials, it has also been possible to determine other elements, particularly those present in very small amounts, the metallurgical significance of which is only now being investigated. Gases such as oxygen, hydrogen and nitrogen are now determined by the vacuum-fusion method.

Mechanical Tests

The oldest tests for cast iron are mechanical, and the original mechanical test is the transverse test in which a bar is broken as an end-supported centrally-loaded beam. It is still used to-day, though the method of assessing strength from this test has changed from an arbitrarily-expressed load required to break a bar, to the conversion to a rupture stress (tons per sq. in.) which is bound to have regard to the size of the section. In the earlier part of the century, the standard transverse test was carried out on a 2 by 1 in. bar. The Admiralty preferred a 1 in. square bar. These were replaced by the round bar in 1928, and the B.S.I., in a general specification for testing cast iron, adopted different sizes of test-bar to represent different section thick-

nesses of casting, reflecting thereby the variation of strength with section found in all cast metals.

As the strength and uniformity of cast iron improved, more attention was paid to the more easily understood and readily conducted tensile test. It was incorporated in the B.S.S. 321/1928, the sizes of test-pieces being the largest that could reasonably be machined from the broken halves of standard transverse bars. The latest form of this specification, B.S.S. 1452, now covers strengths from 10 to 26 tons per sq. in. in 1.2 in. dia. bars. Nodular irons cover a range of strength not reached in the current specifications.

Development in the metallurgy of cast iron has led quite logically to the extension of the fields of application, where cast irons are subjected to shock and dynamic stressing conditions. In an attempt to meet the need for a means of assessing shock-resistance the B.S.I. have issued an impact test for cast iron (B.S.S. 1349). Whilst the B.S.I. have specifications to cover only transverse, tensile, impact and hardness, other information is being sought by designers and is being obtained from tests such as torsion, fatigue, damping and also from both high- and low-temperature tests. For engineering purposes, for which the great bulk of cast iron is used, it is likely that specifications will continue to rely on tensile and/or transverse strength, although the development of nodular iron will need attention, particularly in view of its relative ductility. The American Society for Testing Materials already has a provisional specification for this material.

Plant and Equipment

While the evolution of plant and equipment in the industry cannot be ascribed to formal research, it should be mentioned in this connection, because the technical and operative aspects of foundrywork cannot easily be separated. Since the beginning of the century, the large bulk of foundry plant and equipment beyond that required for floor-moulding or bench-moulding, has come into use. For example, both pneumatic and electric moulding machines and hand-tools, and the Sandslinger; the mechanical-charging of cupolas (including the drop-bottom bucket); the electromagnet in the stock-yard; shot-blasting in the fettling shop, which replaced sand-blasting, and the use of mechanical methods of applying the shot as distinct from pneumatic; wet methods of fettling under pressure; continuous core-drying, particularly the vertical oven; the use of lighter and more precise moulding-boxes of steel and light alloys; snap-flasks and slip-flasks; core-blowing machines; and the use of local lifting methods in addition to the overhead crane, whether by jib or hoist or fork-lift trucks in conjunction with a stillage system. Mechanized production can increase the output two or three times from a given floor area and can double the output per man. It aids in dealing with the problem of foundry atmosphere and encourages the use of green-sand or skin-dried moulds, but an essential pre-requisite of mechanized production is technical control.

FIG. 3.—*View of the Machine-shop at Alvechurch, inaugurated in* 1950.

Education and Training

Closely connected with improvements and the men required to create and use them in daily foundry practice, is the increased provision made in the industry for education and training. The British Foundry School, started in 1935, was re-established at Wolverhampton after the war as the National Foundry College and gives to suitable men in the industry a year's full-time training in foundry metallurgy, foundry technology and management, and in dealing with the problems which daily beset the foundry manager. A preliminary six-months course provides for those below the standard of admission to the Diploma course. The National Craft Training Centre at West Bromwich also meets a need not hitherto provided for in the training of craftsmen. Many firms in the industry make and have made their own provision for apprentice training. Many technical colleges run courses for City and Guilds certificates, for the National Certificates in metallurgy and special courses for advanced students.

Future

If this record means anything at all, it signifies the

road of progress in the future; improved quality, better designs making use of quality to reduce weight, greater uniformity and homogeneity of product; greater dimensional accuracy and lower machining tolerances; greater productivity; better working conditions. The full-employment situation demands the maximum output from a minimum of raw materials; the shortage of materials demands the maximum output of good castings from a given quantity of raw materials. By 1960, the industry could be transformed.

The first quarter of this century has demonstrated the value of research, and during the second quarter the value of systematic and organized research has been demonstrated, so that advances are no longer left to the individual, as is the case in an industry dependent mainly on invention for its progress. For a time, scientific contributions were regarded as were inventions, the sporadic efforts of men with a particular bent placed in circumstances which provided the opportunity. Later it became appreciated that sustained scientific work could be placed on an organized basis and that it could not be left wholly to men bearing major responsibilities with respect to production.

The industry now has the necessary nucleus in the B.C.I.R.A., created by a group of far-sighted men. Integrated with other institutions in the industry, the J.I.C., and C.F.A., the I.B.F., the technical Press and the institutions for education and training mentioned above, it would form a whole capable of dealing with any problem the industry is likely to raise. The three major functions of the Association are the creation of new knowledge by research, its application in the industry through development (the department for which acts in liaison with the industry and deals with current operating difficulties) and its dissemination through the intelligence organization. More recently, an operational research team has been set up to aid in increasing foundry productivity and another group has been initiated to study the question of foundry atmospheres and hygiene. The problems are three in number: those of a technical and scientific character; those involved in securing greater productivity, that is, rate or production or output; and finally, those involved in the materials economy, to make good products from varying raw materials and using an irreducible minimum, so that the greatest possible output of good raw castings comes from the smallest given amount of utilized material. Already, the pipe-dreams of the past have been translated into the practice of to-day and for future progress there is firm confidence in the industry's well-established organizations pledged to development work.

Flying Start for Research

In 1921, soon after the inauguration of the British Cast Iron Research Association, the following were listed in the FOUNDRY TRADE JOURNAL as research problems submitted by founders who were members of the Association and upon which work was envisaged:—

(1) Cast iron analysis and cupola mixtures suitable for castings subject to growth during service; (2) abnormal structures in malleable iron castings, composition of metal and heat-treatment for its avoidance; (3) the elimination of shrinkage defects in grey-iron castings; (4) the curing of hard white cores in the interior of grey-iron castings; (5) the composition and treatment of ganister and other cupola and furnace-lining refractories; (6) the use of steel and iron turnings in cupola charges; (7) investigation concerning composition of stucco and plaster patterns for machine moulding; (8) moulding and facing-sand mixtures for light castings in green-sand; (9) moulding and facing-sand mixtures for " semi-steel " castings; (10) the correct analyses of " semi-steel " for light, medium, and heavy castings, the rationale of mixing, charging, full-ratio air supply, and casting temperatures for " semi-steel " work; (11) cupola coke analysis and physical composition as influencing hardness of iron produced; (12) preliminary stages in the pig-iron grading problem; (13) fundamentals in design of annealing furnaces for malleable castings; (14) internal casting strains in castings and their correction; (15) cast iron of suitable composition to resist erosive and corrosive action, as in centrifugal pumps, valves, pipes, etc.; (16) metal mixtures for increasing the life of annealing pots; (17) shrinkage and density of grey-iron castings; (18) shrinkage and blowholes in small castings; (19) moulding sands for light castings; (20) metal mixtures for hydraulic cylinders; (21) defects due to mixture in chilled castings; (22) design of rollers, suitable mixture for special wheels with steel spokes; (23) cupola proportions; (24) briquetting cast-iron and steel turnings for cupola mixtures; (25) warping troubles in flat castings; (26) fluxes for desulphurizing in cupola coke charges; (27) " draws " and shrinkage defects, and their remedy.

It was later announced that work had been commenced on the following projects:—

(i) Shrinkage defects, " draws " and shrink-holes in castings; (ii) sulphur holes and hard spots in small castings; (iii) abnormal fractures and structures in malleable castings; (iv) standardization of testing methods of cast iron; (v) grading of pig-iron; (vi) cupola and ladle linings; (vii) moulding sands; (viii) motor-car cylinder castings; (ix) alloys of cast iron for resisting erosion and corrosion as in centrifugal pumps, valves, pulverizers, etc.

From the earlier list is apparent the nature of the problems which were besetting foundrymen of 30 years ago and that many of the headings still stand to-day is not to say that much progress has not been made towards their solution in the meantime. Changed conditions have aggravated some, dressed others in new guise, and disposed of many. The emphasis on the now obsolete term " semi-steel " is indicative of the need at that time for real metallurgical research—a condition since happily remedied.

50 YEARS

Phenomenal Growth in Light Alloys

By Dr. E. G. WEST

Fifty years ago the aluminium casting industry had scarcely been born—indeed, the earliest known object cast in aluminium is but 96 years old, having been made by Deville and now resting in a Toronto museum. The adolescent period of the industry spanned the 1914-18 war when it partnered the equally youthful aircraft industry with fruitful results to both. The end of the last war and the subsequent six years mark the adult life of the foundry side of the aluminium industry, and until the recent shortage of metal due to rearmament, the rate of growth promised to continue.

Fifty years ago, world production of aluminium was some 7,000 tons per annum—to-day, the aluminium founders of the U.K. alone produce this weight of castings every six weeks. There has been a fivefold increase since the years preceding the outbreak of war and the 1943 peak has been almost reached again. In this period, the founders have not depended to any appreciable extent on aircraft orders but have secured a place in the general engineering industries of the country.

Fifty years of growth have currently seen a tremendous improvement in the quality of the castings produced, in the range of alloys available and in the variety of methods of casting employed. Of especial importance has been the change in the attitude of much of the industry towards research and development, laboratory control and inspection, and the establishment of British Standards. In case the picture may seem too good to be true, it must be recorded that there are still some founders—and many more users of castings—unable or unwilling to select, specify and obtain the most suitable alloy and process in relation to the design and duties of the finished castings—to the detriment of the aluminium industry itself and to all its sections.

As it is clearly impossible to deal with all the advances in aluminium castings of the past 50 years, this summary is presented to encourage more detailed study by all interested in the production, development and use of the products of the industry. It is divided into the following four parts:—Alloy development, basic research work, processes, and development of new applications.

DEVELOPMENT OF CASTING ALLOYS

Possibly the earliest castings made commercially of aluminium were pots and pans for which the pure metal—a comparative term in this instance—was suitable, although difficult to handle in the foundry. A few ornamental items, including several statues by Gilbert (as well as his best-known—Eros), remain as reminders to-day, but, by the turn of the

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He is a Fellow of the Institution of Metallurgists, a Fellow of the Royal Society of Arts, Member of the Institute of Metals, Member of the American Society for Metals, Member of the American Institute of Mining and Metallurgical Engineers. He is closely associated with the work of the British Standards Institution, the British Non-Ferrous Metals Research Association, the British Welding Research Association and other research organizations.

[Courtesy, Birlec, Limited

FIG. 1.—*Induction Furnace used for Melting Aluminium Alloys for a Pressure-die-casting Machine.*

century, experiments on alloying had made some progress. The addition of zinc as an alloying element was becoming established but the amount of zinc required to produce a useful increase in strength is high and the alloys are consequently appreciably heavier than the pure metal. They are not readily castable, but additions of copper improve this property and also yield greater strength. The best-known alloy of this group was BS.L5, containing nominally 12 per cent. zinc with 2 to 3 per cent. of copper, and it found extensive use for aircraft and motor-vehicle components. It was not possible to die-cast this alloy, however, owing to hot-shortness, and considerable skill was necessary to produce the more intricate castings then made.

The next important stage was reached when the binary aluminium/copper series came into use, being suitable for gravity die-castings. The 12 per cent. copper alloy became well known as BS.L8 and later the 7 per cent. alloy at BS.L11. They were generally adopted in the 1920 decade for automobile castings, especially pistons and other parts used at raised temperatures, and several variants were subsequently developed—for example, a 2 per cent. silicon addition in the D.T.D. 84 alloy.

The requirements of internal-combustion-engine designers led to the successful conclusion of research at the N.P.L. and later by Hall and Bradbury into still better alloys for high-temperature service. The addition of nickel gave Y-alloy and the well-known RR-alloy series included additions of titanium as a grain refiner. The heat-treatment of casting alloys thus became accepted and the importance of purity was standardized in such specifications as D.T.D. 298, 304 and 361 which covered the 4 per cent. copper alloy.

Silicon and Magnesium Alloys

Many early attempts, dating from the last century, to alloy aluminium with silicon were unsuccessful, but the discovery of "modification" by sodium additions to the eutectic alloy by Pacz was followed by commercial development in this country during the 1920-30 period, and BS.L33 is still one of the most-widely-used compositions. It is exceptionally easy to cast as it runs well in thin sections and has a low specific gravity. Variants of the basic 12 per cent. silicon alloy were found to be heat-treatable (as D.T.D. 240 and 245), and the lower coefficient of thermal expansion of the alloy made it useful for pistons.

The alloying of aluminium with magnesium had always been attractive as the density was reduced, but this series was not brought into commercial use until the early 1930's when the nominal 5 per cent. alloy found employment for marine purposes, and in food processing plant. This alloy is not easy to handle in the foundry, however, but a little later the 10 per cent. magnesium alloy was introduced successfully, in spite of still greater difficulties in handling and treatment. As D.T.D. 300, it was used extensively for highly-stressed parts of aircraft in the last war and has since been found very useful for many special engineering applications.

Secondary Alloys

Perhaps the most significant alloy development was forced upon the industry by the wartime metal position, namely the official recognition of several alloys made from scrap. The best-known was patented in 1939 (nominally 2 per cent. copper plus 5 per cent. silicon) and was developed as D.T.D.

424, followed by D.T.D. 428, with 6 to 8 per cent. copper and 3 per cent. silicon, for less-exacting duties. Other compositions enjoyed great popularity during the war, under various "LAC" (Light Alloys Control) designations. The accepted use of so-called secondary alloys was a great step in the economic and technical story of the aluminium foundry industry and is closely linked with the successful refining and reclamation of scrap developed by war-time necessity and continued to the advantage of the nation in peacetime.

Finally, in 1949, the new schedule "Standard Casting alloys for General Engineering Purposes" was published as BS. 1490, and it is essential to the future well-being of the industry that the twenty alloys of this standard should be specified by users whenever possible. The system of nomenclature adopted—L.M. (standing for "Light Metal") followed by an alloy number (1 to 20) and a suffix to show the condition—is simple but comprehensive, and should do much to dispel the mystic but annoying significance of the innumerable designations in use before BS. 1490 was issued—and (regrettably) by many people since. The basic compositions and the resulting properties are well summarized in several recent publications[1] and it is strongly recommended that founders and their customers should adopt BS. 1490 alloys to the advantage of everyone concerned, not only at present but more especially in the future.

Alloy development has made great progress in 50 years but it will not result in the advantages that founders and users may expect unless there is vigilance to maintain the standard of the basic material and skill in designing the component to obtain optimum properties from a given foundry technique.

BASIC FOUNDRY RESEARCH

Fifty years ago, the very small amount of foundry research was devoted to cast iron and some of the other well-tried, older metals, with little thought of even the problems involved in casting aluminium. One of the most striking advances is therefore the realization of the aluminium founder that research is worthwhile and essential to the well-being of the industry. It is unfortunately true that many members of the foundry industry still do not apply the results of research as promptly or as rationally as the more advanced concerns. Nevertheless, there is little doubt that the attitude of the industry towards research and development has already undergone a profound change, and the important task now is to bring similar enlightenment to all its units.

At least one problem has been continuously investigated since the earliest days of the aluminium foundry, namely alloy improvement. The results achieved have already been summarized in the previous section, and research continues in many laboratories to-day. Some of the early work was undertaken by teams such as the N.P.L. staff under Rosenhain, but the major portion of present research in this field has always been, and continues to be, in the hands of individual companies.

Gas Porosity

Gas porosity was recognized as a major problem more than thirty years ago and intensive research at the N.P.L. and by the British Non-Ferrous Metals Research Association in this country gave means of overcoming the gross unsoundness experienced until about 1930. The high solubility of hydrogen in aluminium above the liquidus was found to be the basic cause of porosity and several remedies were proved satisfactory. Degassing the melt by chlorine or halide fluxes has continued to be the normal method, coupled with precautions to avoid hydrogen contamination in melting and casting.

More recently, another form of gas unsoundness has been investigated and the underlying reasons elucidated. In the alloys containing magnesium a reaction occurs when the metal is poured into sand moulds, giving a characteristic form of porosity that seriously reduces the properties of this valuable class of alloy. Work by the B.N.F.M.R.A. on metal/mould reaction has been shown to be effective in commercial practice but much remains to be done in many foundries before castings in the magnesium-containing alloys are invariably produced free from such unsoundness.

Hot Cracking

Hot cracking or tearing has, of course, always been a problem and has prevented certain alloys from being cast in metal dies and it is only within the last 10 to 15 years that the basic causes have been established. Again, the B.N.F.M.R.A. investigators have been prominent and the "eutectic index" described by Lees is a valuable indication of the inherent tendency of an alloy to hot shortness.

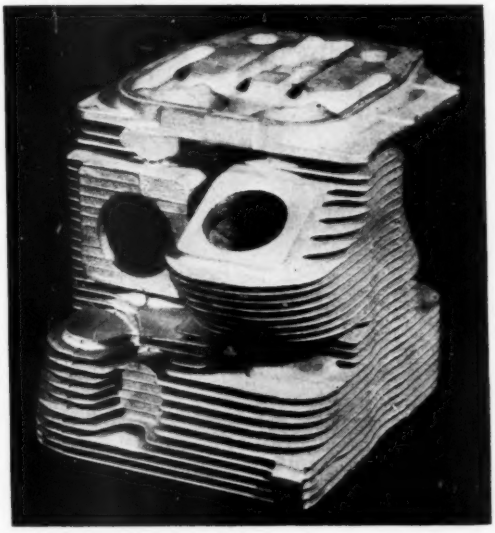


FIG. 2.—*Air-cooled Aircraft-engine Cylinder-head, cast in LM-14 by the Suction Process.*

Composition is thus a principal factor, but there has been some useful practical work directed towards controlling the gas content in such a manner as to reduce the risk of hot cracking.

Grain Size

Grain size has been long recognized as a major factor in determining the mechanical properties of aluminium casting alloys and additions of titanium have been made for 20 yrs. for the purpose of obtaining small, uniform crystals. The mechanism of grain refinement by titanium and boron has not yet been fully determined, for only recently an American paper has lent support to the peritectic theory which was discarded by the B.N.F.M.R.A. investigators in favour of boride and carbide formation and concentration gradients. It has, however, been accepted in practice that additions of titanium and boron reduce the natural grain size of a casting and improve its strength, as well as reducing the risk of hot-tearing. Similar findings have been published in connection with welding research on aluminium alloys.

Sand Control

Control of moulding sand has been developed as a result of a great deal of attention to applying the data obtained from some of the foregoing researches, plus practical observation of the effects of different types of sand on the final casting. The use of inhibitors to reduce metal/mould reaction is an example of the type of development which has brought scientific control right into the foundry. To-day sand control is widely practised and central processing plants enable sand of the desired properties to be delivered to the moulders, thus reducing surface defects and controlling the properties with a high degree of efficiency.

The phenomena of solidification have likewise been fully investigated and the importance of directional cooling established. The use of chills has been given a more scientific basis and recent work on thermal gradients in castings has greatly helped in interpreting existing knowledge on gas-reactions, grain-size, shrinkage and hot-shortness.

Inspection Methods

Methods of inspecting castings have been the subject of much investigation, and finality has by no means been reached, especially for the high-strength alloys, which are more prone to trouble than others. High specification figures in test-bars are not only misleading but positively dangerous, unless the properties of the casting itself can be related to the standard. No completely satisfactory means of non-destructive testing has yet been devised and quality-control methods are still not entirely satisfactory, although excellent results are obtainable by foundries which have devoted sufficient study to the proper use of the statistical tool. Supersonic testing, fluorscopic examination, radiography and radioactive isotopes—all have their uses—but the ultimate decision as to rejection or otherwise must be based on personal opinion backed by experience, both in the design office and on the foundry floor as well as in the inspection department.

FOUNDRY PROCESSES AND TECHNIQUES

Some indication of the changes in foundry processes and techniques during the past half century may be deduced from the researches already mentioned, and other improvements may properly be attributed to the demands of the user which necessitate better control. Sand casting has been followed by the adoption of metal dies for gravity castings and later by pressure die-casting—all becoming more and more highly mechanized with the passing

FIG. 3.—*Cast Aluminium Dash, Screen-pillars, Door-pillar Sockets and Wheel-arches for 40-h.p. Lanchester, 7-seater Car designed in* 1922.

[*Courtesy, George Lanchester, Esq.*

of the years. Aids to sand casting have been especially developed during the past 10 to 12 yrs., such as machine moulding, sand-handling and processing, metal patterns and mechanical devices to convey patterns, boxes and metal in and around the foundry. Fully-mechanized foundries have proved their worth for high-production runs of more-or-less standard castings, but are not suited to commercial jobbing work, for which, however, many mechanical accessories can be profitably installed.

Size and Quality

The size of sand castings has gradually increased, and recent descriptions of particular jobs show that mere size is no longer the prerogative of the older metals. Thus, 6-ft. diameter pulleys weighing well over a ton have been cast in the 12 per cent. silicon alloy[2] and the rotary vacuum filter casing in D.T.D. 424, described by Fenn,[3] weighed over 4½ tons as cast and 7,207 lb. as delivered.

As will be appreciated, increases in size and improvements in quality have had to be matched by suitable melting facilities. Almost every type of melting furnace can be seen in aluminium foundries to-day and expert opinion is still divided as to the best for particular duty. Many regard the low-frequency induction furnace as the most suitable for heavy and continuous working (Fig. 1), but oil-fired and coke-fired furnaces are still largely used. Aluminium in this aspect provides a strong contrast to cast iron, for which the cupola is an efficient melting unit.

Die-casting

Gravity die-castings have also progressed in weight and complexity, but automatic or partially-mechanized equipment is not yet widely used. There are, however, notable examples of the application of the principles of flow production to aluminium die-casting and further development in this direction is likely when conditions are favourable. The practice of using sand cores in dies has shown promise, although relatively few applications have been described. The Parlanti invention of anodized-aluminium dies created interest but has not been fully exploited as yet.

Pressure die-casting was not adopted for aluminium alloys until less than 40 years ago in spite of its development for other metals some 60 years earlier. The gooseneck machine was not entirely satisfactory for aluminium as the hot metal in prolonged contact with the machine picked up so much iron that the alloys were too seriously contaminated to be usable. Even the 12 per cent. silicon alloy could have its properties seriously impaired by an iron content which was trebled or even quadrupled during a single shift. The cold-chamber machine was adopted in about 1934 and allowed a wider range of alloys to be pressure-die-cast very satisfactorily. To-day, several modifications of the normal gravity- and pressure-die-casting processes

FIG. 4.—*Impression, Gates and Risers of the Die for a Gravity-die-cast Kitchen Sink, with Draining Boards.*

[Courtesy, Northern Aluminium Company, Limited

are in use commercially—in particular, the low-pressure and the vacuum techniques. By these methods, very intricate castings can be made to a high degree of accuracy and soundness as exemplified in Fig. 2.

Cast-in Inserts

The value of casting-in inserts of other metals has been fully proved and it is now commonplace for inserts to be called for in sand and die castings of all types. It is not impossible to have inserts of certain non-metals under special conditions. The use of the lost-wax process has not been entirely overlooked by aluminium founders requiring to make special castings, and there have been useful developments in plastic moulds. Another process which has been the subject of experiment, but is not yet adopted for aluminium, is centrifugal casting. A few successful applications have been described, after earlier scepticism, and the properties of some alloys appear to be capable of valuable improvement by this process. Attention must also be directed to the growing practice of making very complex units by welding together simple castings. Such jobs require care in planning and have been commercially practicable only within the past few years, as the argon-arc welding process has become a more generally accepted tool. This development warrants attention whenever intricate designs are on the drawing board and it may open up a new technique for exploitation in many fields.

Finally it should be noted that by comparison with 50 years ago the aluminium foundry industry is in a much better position to take advantage of new techniques and equipment. Exchange of views and, often, of working data is becoming widespread through the medium of the technical Press, papers to learned societies and institutions, and by direct contact between founders. Here the interest of the Institute of British Foundrymen in aluminium may properly be mentioned and it is fitting that special sessions on aluminium-alloy casting have been arranged at several recent conferences of the Institute.

FIG. 5.—*Cover for the Mechanization of a 165 - kv. 3,500 - m.v.a. Air-blast Circuit-breaker, Sand Cast in LM. 9P. The Housing and Cover together weigh 320 lb. and Four Steel Inserts are cast-in.*

[Courtesy, Wm. Mills, Limited

DEVELOPMENT OF NEW APPLICATIONS

The aluminium founder has increased his output continually as the use of aluminium has expanded, but greater opportunities than ever exist now for the foundry industry to show still greater development. Since the war finished, there have been many temptations to sell aluminium castings as substitutes for material in short supply, and, although in many such instances the advantage of aluminium over the more usual material may be established, it is realized by many founders that it is more important to consider long-term possibilities. It is essential that all units of the foundry industry should base their commercial policy on long-term prospects, as well as naturally keeping an immediate and steady flow of castings through their works. The field for developing aluminium is so vast that there is little doubt that all sections of the industry could be kept at maximum capacity, and this is especially true of the manufacturers of first-class aluminium-alloy castings.

Road Vehicle Applications

Road transport has been the largest single user of aluminium-alloy castings for many years and this application dates back to the earliest days of the industry. Indeed the automobile industry and the aluminium industry have grown up side by side and the particular combination of properties of aluminium is likely to maintain the metal in the forefront of motor-vehicle materials. Most of the applications of castings in road vehicles are in the engine and transmission—in particular crankcases, gear-boxes, back-axle differential castings, a multitude of housings and covers, and, using the alloys specially developed for high-temperature service, pistons and cylinder-heads. The development of methods of satisfactorily hard-surfacing cylinder bores may bring the cylinder block into the aluminium foundry, and it is possible to look forward with confidence to the greater use of castings in the body structure.

It will be recalled that the very successful Panhard-Dyna car embodies many items cast in the 12 per cent. silicon alloy to which aluminium-alloy sheet components and pressings are riveted. British car manufacturers have not yet undertaken development in this direction, but the experience now being gained by the Aluminium Development Association, with a Panhard-Dyna car, obtained for the purpose of tests, should be exceptionally useful in further substantiating the case for cast aluminium throughout road vehicles of all types.

Mention should also be made of the likelihood of cast aluminium-alloy bearings being produced in substantial quantities, and considerable investigation is taking place in this field. For a different type of application, the stronger casting alloys have been successfully used in place of malleable cast iron, and again experience will indicate further advances in this direction are likely.

Railway Fittings

Railways are rightly regarded by the whole aluminium industry as an appropriate field for development work and already substantial quantities of aluminium castings are being used in this country for internal fittings of passenger coaches of otherwise conventional design. As progress is made towards the ultimate aluminium-alloy train, the total weight of castings will inevitably increase, particularly as they are finding general acceptance in place of the heavier and more expensive plated brass. If tradition insists on retaining the appearance of plated or polished brass, then aluminium foundries must produce castings that can be properly finished by anodizing or other means. The structural use of cast aluminium for railway vehicles is perhaps further off, but possibilities exist both for passenger and goods stock.

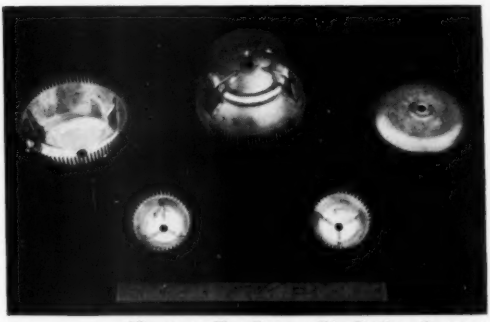
Shipbuilding Uses

Marine applications of aluminium have made very substantial progress in the past 25 years, but present conditions indicate that the adoption of aluminium castings in place of the more traditional copper-base alloys should be accelerated. For exposure to sea air and salt water, it is particularly essential that only first-grade castings in approved alloys should be accepted, and any unsuitable materials fitted to ships do nothing but a disservice to the industry as a whole.

Constructional Purposes

Perhaps the most striking development in the use of aluminium castings has been in the building industry, especially as the past five years have seen the adoption of aluminium for purely utilitarian purposes as distinct from the former use of cast aluminium for decorative features. This has been due in part to the shortage of other materials, but aluminium has justified itself on technical and economic grounds, particularly where maintenance can be taken into account. The publication of B.S. 1430 in 1947 to cover cast-aluminium rainwater goods is an indication of the progress made and with the present emphasis on the building of houses it is hoped that aluminium will be sufficiently plentiful to allow the founders to make an appropriate contribution to this important national problem.

Domestic equipment of all kinds has been a fruitful source of business for the casting industry throughout the past 50 years, but recent developments have again overshadowed those earlier. Many excellent examples of cast aluminium-alloy and pressure-type cookers have been produced in enormous quantities, and their success has led to the adoption of aluminium for large-scale food-processing equipment. Vacuum cleaners have served to introduce the advantage of light weight to housewives and have led the way to many other items of domestic equipment being made as aluminium castings, including several types of furniture both for indoors and the garden.



[Courtesy, Non-Ferrous Die Casting Company

FIG. 6.—*Aluminium-alloy (L.33) Bubble Caps for an Oil Refinery.*

Electrical and Mechanical

Electrical engineering is a relatively new outlet for the aluminium founder, but, although wrought aluminium has been used for electrical purposes throughout this century, recent casting applications have included many types of junction-box, switchgear, connections for trailing cables and motor components, but again only the fringe of such applications has yet been touched. Allied to electric engineering are the more spectacular uses of alloy castings in radar equipment and other electronic gear.

Mechanical engineering has such wide scope that a few examples must suffice to show that aluminium castings have made progress (most of it of recent date)—in mine equipment and machine tools, in textile machinery, in tractors and agricultural equipment, printing machines, cinema projectors, and theatre lighting gear and fittings, and foundry equipment itself—all have benefited from aluminium castings. The advantages include not only lower weight, which is of special importance in reciprocating and other moving parts, but also ease of machining, freedom from rusting and, in many instances, less liability to accidental damage.

In conclusion, it must be remembered that mistakes have been made and disappointment encountered, but the experience built up during the past 50 years augurs well for the next.

REFERENCES

[1] For example, F. H. Smith, I.B.F. Conference Paper (June, 1951), see FOUNDRY TRADE JOURNAL, 1951, 91; Aluminium Development Association Information Bulletin No. 2 and 17 and Alar Publications.

[2] Wilson and Talbot, FOUNDRY TRADE JOURNAL, December, 1949, pp. 761-70.

[3] Fenn, FOUNDRY TRADE JOURNAL, 1951, 91 (1821), pp. 91-92.

Patternmaking

The basic art of patternmaking was just as well understood fifty years ago as it is to-day and a high percentage of matter contained in text-books of that period would not require rewriting for a modern text-book. The major changes have been in the better and more extensive equipment of patternshops and their layout and the change to high-precision patterns for mechanized production. The use of single- and double-sided pattern-plates was established early in the century. There were then fewer metal-pattern layouts, as this phase of patternmaking was consequent upon the extensive mechanization of the industry.

Storage

A problem which has exercised the ingenuity of the foundries with increasing force over the period has been the storage of patterns. In many cases, new buildings have had to be provided and much thought has been given to making them fire-proof. New systems have come into vogue for the classification and rapid identification of patterns. No longer is reliance placed on the memory of some aged pensioner, as was not unusual in early days.

There has been more recently a shortage of the best kinds of timber, but somehow or other the difficulties have been largely overcome, but when improperly seasoned English elm was used production inevitably suffered through warpage during use. Much of the hand work involved in shaping patterns has been eliminated by the introduction of machinery. When aero-engines came into being each fin was hand carved, at a cost of several thousand pounds for the finished jobs. Plastic wood for the making of fillets came in use about 25 years ago.

In quite recent times there have been two new developments in patternmaking. One is the use of plastic or synthetic-resin patterns and the other the pressure casting of aluminium match-plates, in plastic moulds. Neither has yet reached a stage where, so far as this country is concerned, it is readily obtainable or being used extensively.

A steady growth has been registered in the number and importance of patternmakers to the trade; a feature which is still now largely developed in the foundry industry of the United States. Now all important centres are serviced by well-equipped "outside" pattern-shops. So far, nobody has had the initiative to form any sort of "patternmakers association" to enable co-operative activities to be carried out. Maybe such a development is unnecessary in view of the promised lessening of controls.

One pleasing feature is the availability of woodworking machinery of British design and manufacture. In fact, an important export business has built up for the more specialized machines.

The present position of the patternmaking trade is that a number of well-lighted and ventilated shops (as shown in Fig. 1) of excellent construction and layout have been built for the actual construction of patterns, whilst for storage the new fire-proof buildings are being provided in increasing numbers. There is no problem in this industry as to recruitment, for youth is naturally attracted to a trade giving ample scope for the learning of an interesting skilled craft.

Techniques

Technically, there has been co-operation with the designer and foundryman on an ever-increasing scale, but here a word of warning is necessary. As an increasing number of boys are being trained in "independent" patternshops, they do not get that familiarity with actual foundry processes which they will need in later times. Thus, arrangements should be made for such boys either to go to the National Craft Training Centre or to spend a portion of their apprenticeship in, preferably, a jobbing foundry.

FIG. 1.—*Typical Modern Patternshop, showing Spacious Layout giving Ample Room for Setting Out and with Lathes and Special-purpose Machines well segregated from Individual Benches.*

[Courtesy, R. & W. Hawthorn Leslie & Company, Limited]

America Outstripped in 50 YEARS of Malleable Iron

By **F. D. LEY**

Fifty years ago, it was reported that the British malleable castings industry was sadly lagging behind its American counterpart, yet to-day it is well to the fore. The steps by which this worthwhile advance has been achieved are reported in what follows. The Author, from a lifetime's work and family connections is in a privileged position to assess both the impact of individual innovations and the overall trends.

The following words were written at the end of the nineteenth century:—

"The enormous development of the malleable-castings trade in the United States having been brought forcibly under our notice by our intimate connection with the largest producers in that country, we have been led to make enquiry into the causes which have operated against a similar development in this country. Consumers here do not make use of these castings in anything like the quantity they might do if they cut themselves adrift from conventional modes of treatment and strike out boldly in new tracks as our friends on the other side of the Atlantic have done, and enlist the help of a metal which in the hands of our go-ahead cousins has done so much in these days of keen competition to reduce cost and lighten deadweight. The American malleable ironfoundries have profited by the wider diffusion of scientific training; the nature and characteristics of their metal are now well known; the elements that rendered it unreliable in quality and difficult to anneal have been pointed out by the chemists. In this country, the manufacture of malleable castings working on old-world lines with out-of-date plant and producing castings of uncertain quality, has begot a general want of confidence in the metal itself."

The writer, if alive to-day, would certainly be pleased with the transformation which has taken place during the past half century.

The chief products in the past, were agricultural-machinery parts, belt-fasteners, boat anchors and rowlocks, boot protectors, cellar gratings, chimney bases for locomotives, chain links, cycle castings, drinking-fountain cups; electrical, footwear, and furniture castings; hinges, ironmongery, keys and lock parts; milk-can tops and handles, nails, ornamental chain-links, palisading heads, railway castings, saddlery and shipbuilding parts, spanners, saucepan handles, tarpaulin eyelet-rings, tram wheels and textile castings. Thus malleable castings around 1900 were being used in a wide variety of trades. One catalogue at that date had this to say about malleable palisading heads:—

"These have all the delicacy of wrought-iron ones and at the same time are much cheaper and stronger. To prevent the possibility of the heads

Mr. Francis Douglas Ley, J.P., who contributed this article, was educated at Eton and Cambridge and thereafter studied malleable foundry practice in the United States. Following in the family business, he was appointed general manager of Ley's Malleable Castings Company Limited, in 1935; joint managing director in 1939 and chairman of Ley's Foundries and Engineering Limited in 1944.

being unscrewed by mischievous persons, it is simply necessary to wet the threads of the screws with water in which a little sal ammoniac, which can be bought at a druggist for a few pence, has been dissolved."

Present-day Application

To-day the motor industry is the largest user of malleable castings for both passenger cars and commercial vehicles. Such parts as axle-housings, differential carriers, cases and covers, hubs and drums, spring brackets, steering boxes, pedals and hinges are made in large volume as malleable castings. Agricultural machinery and tractors, cycles and motor-cycles, conveyor chains, electrical machinery, mining equipment, general-engineering and tube-fittings, employ malleable castings to a considerable extent. The demand for malleable castings is constantly expanding, for new applications and some of the latest developments cover pistons and crankshafts. Although from time to time there is a flurry over some new material which is extravagantly claimed as replacing malleable, experience and lengthy trials in the end prove malleable to be the best material on account of its easy machinability, strength and toughness in resisting shock.

Materials

Fifty years ago, the pig-iron was mainly English refined, English charcoal and Swedish, whilst large quantities of charcoal iron were imported from the United States during the summer when the Great Lakes were open to shipping. The pig-iron was mainly melted in small plumbago crucible furnaces, small cupolas and small air-furnaces. The larger firms had modest laboratories where the pig-iron was analysed, and the laboratory specified on the charge sheet the quantity of each grade to be used on the furnaces. To-day the pig-iron is English refined, and English hematite, and steel scrap, melted in large cupolas, air-furnaces, rotary furnaces and by duplex cupola/electric melting.

FIG. 1. — *Mechanized Moulding Plant for producing Medium-size Malleable Castings.*

Pulverized Fuel

The small air-furnaces used to be fired by hand with hard coal, but the increased size of the furnaces, requiring long-flame conditions, necessitated the use of pulverized coal. The first pulverized coal plant for malleable air-furnaces was of the central-station type, which consisted of elevators and hoppers for storage of coal of bean size, and coal driers to remove the moisture, Bonnet type roller mills for powdering the coal and large hoppers of 50 tons capacity fitted with batteries of feed screws for withdrawing the powdered coal into the pipes in which the coal was blown for distances up to 1,000 ft. to the melting furnaces. In the pioneering days, considerable trouble was caused by the vertical static driers being difficult to control, thus causing fires in the storage bin due to overheating, and at other times complete blockage of the pipe-lines to the furnaces owing to the coal being improperly dried. Sometimes heats were delayed far into the night, and the moulders and casters went home at 5.30 p.m. and came back at midnight to cast their moulds. At other times, fires in the 50-ton bin made it necessary for the operators and fire brigade to empty large quantities of the smouldering coal out of the bin. However, these troubles were gradually cured by the installation of rotary driers and Hardinge ball mills and to-day these central pulverizing plants are producing hundreds of tons per week without any hold-ups and difficulties. The use of unit-type Atritor mills for new melting furnaces has now become popular, since such mills, supplied with coal-handling equipment and drier, can be placed adjacent to each melting unit. The only backward step in the development of the use of pulverized coal for metallurgical purposes has been the increase in ash-content of coal from the previous figure of 3 per cent. to the present-day figure of 6 per cent.

The development of pulverized coal has also made possible the installation of waste-heat boilers connected to melting furnaces and the steam produced is used for the generation of electricity and the heating of buildings. This generation was originally mainly valuable from the economic point of view, but to-day its availability has provided a welcome relief from power-cuts.

Furnaces

A major development in the melting of both whiteheart and blackheart malleable, was the advent of the rotary furnace in the early 1930s. The advantages of this type of furnace were numerous, and in different ways, benefited whiteheart and blackheart practice. Closer control of chemical

FIG. 2.—*Mould Storage on Roller Conveyors for Batch Pouring of Malleable from a Crane Ladle.*

composition and higher pouring temperatures than with cupola melting were obtained. A greater freedom in choice of melting stock was possible, and in the case of blackheart metal, low carbon and sulphur compositions could be produced. Rotary-furnace capacities generally vary from two to five tons, and oil, pulverized bituminous and anthracite coals are used as fuel. The oil- and anthracite-fired types are normally equipped with recuperators and all furnaces are operated with monolithic siliceous linings.

Ancillary Sections

Parallel with the rotary-furnace development, malleable cupola practice has been improved in metal composition and temperature, by the use of heated receivers, employing oil, gas and the electric arc, whilst advances in cupola design in the malleable industry are represented by hot-blast and water-cooled cupolas, examples of each being in operation to-day.

The transfer of metal to the moulds by hand ladle is now gradually being replaced by metal transfer in bogie ladles, ladles on monorails, and electric-crane ladles. The immersion pyrometer has made it possible for metal temperature to be recorded much more accurately than with optical pyrometers and other previous methods.

Laboratories in the industry are provided with the most modern equipment, such as the spectrograph for determining silicon and manganese on which an accurate analysis can be determined in 12 min. as compared with 30 min. chemically, and carbon on Ströhlein apparatus where the result can be obtained in six as compared with 15 min. previously. Equipment such as this has greatly speeded-up the analysis of batches of samples from large numbers of furnaces.

The skill and craftsmanship of the patternmakers were well known at the beginning of the century, but the complexities and intricacies of modern design, where one complicated casting often replaces two previously used, and the greater dimensional accuracy required by machine-shops, has called for even greater skill and has further enhanced their reputation, and also made it essential for the pattern-shops to be equipped with modern precision machines.

This demand for greater accuracy and the higher volume of production has placed larger responsibility on management in their task of exercising quality-control. From the inception of a new job there must be proper planning and consultation between all departments.

Moulding Machines

The equipment of moulding machines and moulding methods has made remarkable advancement. Moulding 50 years ago was mainly bench, floor, spray and tub. The increasing volume of castings required per week made it necessary to employ faster methods of moulding and machines designed for hand-ramming, hand-squeeze, and withdrawal of patterns were the fore-runners of the power-operated machines in use to-day. The various types now available—squeeze, jolt-squeeze, stripper, jolt-squeeze-turnover and jolt-rollover, give speedy ramming times and quick and accurate pattern-draw with different principles of operation such as four-pin lift, stripping plate, down-sand frame, turnover and rollover. For smaller and shallower work, the electrically-operated moulding machine is popular. This embodies pattern-withdrawal mechanism by either stripper plate or down-sand frame. Many of the modern types of machines incorporate continuous heating of the pattern-plate to ensure good lifts and draw. Fig. 1 shows moulding plant and

FIG. 3.—*Pouring from an Electric Furnace in a Duplex Melting Plant*

Fig. 2 moulds arranged for batch pouring in a modern foundry.

Hourly outputs from all the machines depend on the layout surrounding them, and the provision of overhead sand-hoppers, roller-conveyors, powered conveyors and mechanical shake-outs, has enabled excellent production to be achieved by labour which, although intelligent, keen and hardworking, could not be classified as skilled as in the old days, when the artizan moulder made his own joint-line and decided on the situation and size of his runners and feeders. With some fully-mechanized plants, outputs of 120 moulds per hour per pair of machines are regularly obtained, illustrating the tremendous advance in productivity over the loose-pattern moulding method. The technique of running and feeding has also made considerable progress and many ingenious methods are now used to produce sound castings free from slag and with the minimum of feeders and sprue. Fig. 3 shows pouring in progress.

Many malleable foundries favour the use of synthetic sand instead of natural-bonded sand for moulding. Sand testing and control has become a skilled science and the physical properties, ramming densities and behaviour in the moulds are recorded and reviewed at definite periods. With mechanized units to-day, continuous sand-mills are frequently used.

Foundry Inspection

The amount and type of scrap in the foundry, in the process departments and in the customers' machine-shops, is regularly recorded, inspected and analyzed and action is taken to reduce their incidence to a minimum. The control of scrap to the lowest possible figure plays a most important part in the economics of the foundry and is receiving closer attention than formerly.

The following was written in 1908:—

"In the manufacture of malleable castings, an enormous and infinite variety of cores are needed daily. The small cores are made by female operators, but many of the most intricate cores are moulded by machines of very ingenious design. Cores are dried in a series of ovens heated by gas, the temperature being automatically registered and regulated. The cores are then stored in a warehouse which is heated by steam pipes to a uniform temperature which preserves the crisp, firm texture of the cores. To ensure the correctness of the core-boxes being retained, many of them are made of hardened steel, and an expert is employed to gauge daily those in work."

Coreshop

To-day there has been considerable advancement in coreshop practice. The silica sand of selected grain-size is usually dried and cooled, and measured amounts of binder and water are added which are accurately controlled. The introduction of core-blowing has resulted in an increased production rate of cores and the technique associated with it has become a science in itself. There are many designs and sizes of core-blowers and their selection depends on the type and size of core to be blown. Outputs of 250 blows per hour per machine on small cores and 75 blows per hour on larger cores with one operator are now quite usual and the core-blower has become an indispensable part of mechanized production. The extrusion or "sausage"-type coremaking machine is also popular. Fig. 4 shows a typical modern coreshop.

The former batch-type ovens have been largely replaced by the continuous vertical oven fired by coke or gas, with the core-blowers situated around the oven, or with the cores carried to the oven on steel-band conveyors.

Fettling

Cleaning of malleable castings is usually necessary both before and after annealing. Views have been put forward that cleaning before annealing is not necessary so long as the castings are cleaned afterwards, but the economics seem to show that the extra cost of cleaning before annealing is offset by the quicker detection of foundry scrap and the avoidance of annealing castings which are subsequently found to be defective.

The old type of rumbling barrels, in which iron stars and leather were used to clean the castings, produced a clean and polished surface but the process was apt to round off the sharp corners. The more fragile castings before the annealing treatment were placed in vitriol tanks and left overnight. Compressed-air sand-blast barrels and chambers gradually replaced the rumbling barrel and sand was later discarded for steel shot, in the interest of health. Chilled angular shot and malleable round shot have been used successfully, but the high price of malleable round shot has not been in its favour The advent of the centrifugal shot-

throwing machine has been a valuable development and modern machines of this type clean the castings very efficiently. It is helpful for weekly tests to be made of the shot in the equipment, to make sure that its condition is retained at its highest efficiency.

After cleaning in the hard state, the castings are trimmed to remove flash or ties which have been put on to prevent pulls, and then inspected. Pickling and magnetic crack-detection are used to assist in revealing surface defects. The immediate reporting by the trimming inspection foreman to the foundry foreman of the various forms of scrap of each casting is most important so that action can be taken quickly to rectify the trouble, and this has become more necessary to-day with the high production from mechanized plants. Close liaison between the foundry foremen, processing foremen and inspection is essential.

The castings are then counted and weighed for payment to the moulders and for the records of the progress department. An extract in 1908 reads:—

"All the castings being moulded piece-work, accurate booking is of great importance, and to avoid possible disputes in respect of count or weight due to mistakes unavoidable at times, the men are permitted to employ a check weighman who devotes his whole time to their interests and is paid by them."

Annealing

The annealing of castings is one of the most important processes and also the most lengthy. Around 1900, ovens were usually of small capacity (about 5 tons), hand-fired with coal or burning producer gas. In some of these ovens, the castings were taken in by wheel-barrows and packed inside the oven in oxides in round or square pots. In other cases, the pots were packed in the department and the stack of pots taken into the oven by a manual fork-lift truck. After annealing, the pots were taken out of the oven by the truck to the cooling-off room, and then to the dumping room where they were emptied and the castings separated from the oxide. The oxide was removed to the oxide room, where it was spread out and treated with sal ammoniac and then dried. Test-pieces were taken from each pot and broken before the castings were passed to the next process. An early document quotes:—

"The annealing is a delicate process, the heat required is too great to be gauged by pyrometers. The eye of the person responsible for the firing of the ovens determines the correct heat and in very hot weather in summer, the rays of the sun make it very difficult to determine and at such times only the most experienced men can be employed. If the heat is too high, the castings collapse in the pots and are so twisted and distorted as to be practically useless. Without skill and experience, hard bakes, as such mishaps are termed, are of frequent occurrence."

The Author has in his possession a telegram from his grandfather to his father dated August 5, 1907:

"J's metal execrable quality run from too-soft iron. You have used too much X's iron also burnt same annealing due to probably dirty scale and ovens getting too hot at sunset. In very hot days use higher grade mixture. Had same trouble for 20 years in July and August. You must see every oven dumped and test contents most carefully, better scrap bad ovens rather than send such work away. I had to do this six years ago due to supplies of bad iron and intensely hot days making annealing difficult. Go works to-day and warn annealer."

This telegram is an example of the difficulties encountered by these pioneers and the energetic steps they took to maintain their reputation for quality.

Evolution of Furnace Design

The open-flame batch-type annealing oven has continued in favour throughout the years and has been the subject of many improvements. It is only recently that revolutionary designs have in marked degree superseded the old standard periodic type. These new designs will be referred to later. Though the old internal fire-box, hand-fired, coal ovens were greatly improved by arranging external fireboxes, the major firing advance was by the

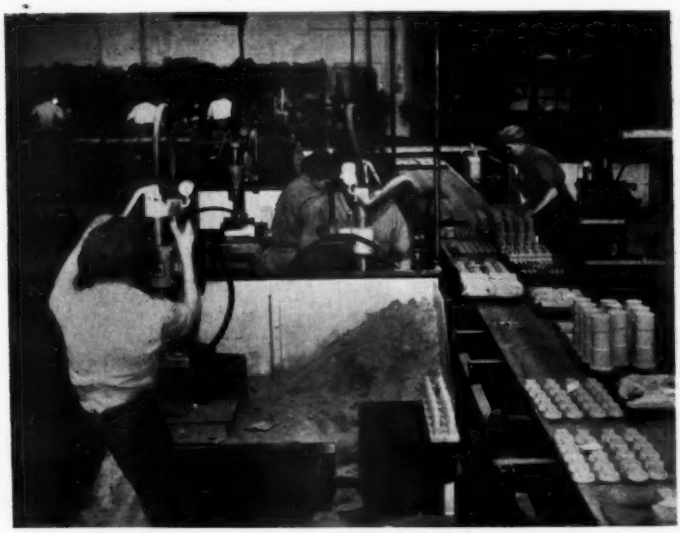


FIG. 4.—*Small and Medium Core-blowing Machines and Steel-band Conveyor leading to Vertical Core-ovens in a Malleable Foundry Coreshop.*

introduction of pulverized coal. This gave faster heating rates, more-uniform temperatures and economy in fuel consumption. Adaptions were made to both side- and end-fired ovens. Similar developments were made by the use of town's gas, producer-gas, oil and creosote pitch.

As better and more diverse insulating materials became available, ovens were insulated on roofs, side-walls and even floors, giving further savings in fuel and more-uniform temperatures throughout the oven. Lightweight refractory insulating bricks enabled doors to be constructed which could be removed by fork-lift truck or opened on hinges, replacing the practice of bricking-up with firebricks.

The old method of packing and unloading pots inside the oven, or placing the pots with a cumbersome hand-operated fork-lift truck gave way to the use of battery-operated fork-lift trucks and to bogie hearths. When the bogie hearths are withdrawn from the ovens the pots are loaded and unloaded by a travelling crane (Fig. 5).

Temperatures originally judged by the eye of the skilled fireman were later measured by optical and radiation pyrometers. Improvements in thermocouples, protecting sheaths, in indicators and recorders have resulted in their universal adoption. Methods have been developed enabling the thermocouples to be immersed in the pot, giving the temperature of the work instead of the fluctuating oven-gas temperatures.

In whiteheart annealing, attention has been given to the cleaning of the annealing ore by screening-out pan scalings and dust arising from the ganister and sand pot luting. Blackheart metal, originally packed in very weak ore or in mill-scale, was subsequently packed in inert materials such as sand, gravel or crushed slag. Some manufacturers have been able to dispense with packing material in the annealing of blackheart by the use of heavy rebated pots with solid bottoms or splitting plates.

Continuous bogie-type ovens have been introduced for the pot annealing of both whiteheart and blackheart malleable. These have been variously fired by town's gas, producer gas, creosote pitch, and pulverized coal. Economies in fuel and improved product due to the better temperature control are the major advantages.

Controlled-atmosphere Furnaces

Chiefly through the efforts of the furnace builders, the desire to eliminate the dead load of pots and packing material has resulted in the introduction of controlled atmosphere for the annealing of whiteheart and blackheart. In the case of whiteheart, a de-carburizing but non-scaling atmosphere is used. The earliest de-carburizing atmospheres were produced from partially-burnt town's gas re-circulated and re-generated by air. In the latest process, atmospheres are regenerated by steam in a system which is self-regulating and the steam is raised by combustion of the exhaust gases from the annealing furnace. In blackheart annealing, the controlled atmosphere, which must not be de-carburizing or scaling, is self-generated from the occluded air and its reaction with carbon in the surface of the castings. When cooling, the highly-reducing atmosphere is diluted suitably with air to prevent re-carburization.

The controlled-atmosphere processes need a furnace which is free from the products of combustion of the heating fuel and which can easily be made gas-

FIG. 5.—*Crane Loading of Bogie-hearth Pulverized-coal-fired Annealing Oven.*

tight. This has led to the use of furnaces heated by electric radiant elements or by radiant tubes using producer gas or town's gas. Two types of furnace have best met the requirements, the elevator type in which a bogie hearth is elevated into a fixed furnace mounted above floor level, and the bell or " top-hat " type in which the furnace is lifted off a fixed base. Where the elevator type is used for blackheart annealing, a two-stage process is operated wherein one furnace is kept for the high-temperature treatment and a second furnace is used for controlled cooling. Provision is made in both types of furnace to effect forced cooling over a suitable temperature range by blowing cold air through multiple tubes. In controlled-atmosphere furnaces, automatic temperature control is used and, in the case of blackheart annealing, specified cooling rates are obtained by programme-type temperature controllers. The use of these furnaces results in a saving of pots, packing material and labour, and enables shorter annealing cycles to be operated which greatly increase the throughput for a given floor space. The special features of design and control have contributed to an improved product. Fig. 6 shows a modern gaseous-annealing furnace.

Castings after annealing are then cleaned before passing into the fettling department. In the early days, power for the grinding shop was provided by a steam engine driving a main shaft connected by a mass of pulley wheels and belts to the emery wheels which were revolved at speeds up to 5,000 ft. per min. These silicon-carbide wheels were rubber-bonded and gave off a strong smell in the neighbourhood of the department. Modern practice has employed the use of independent motor-driven Alundum wheels which has resulted in cleaner and lighter shops, and with the wheels now running at 9,000 ft. per min. has greatly increased the efficiency of the grinding process. Ties placed on the castings to offset pulls usually require removing by chisel and hammer or pneumatic tools.

Straightening

The majority of castings then require straightening to correct any distortion which has taken place during the annealing. For many years, this straightening has been carried out by hand or by fly-presses and drop-presses. Modern practice is generally to use drop-hammers or large presses with specially-designed dies for each casting. Castings are then finally inspected and use is again made of modern flaw-detection processes. Gauging has become more elaborate, and it is not unusual to apply duplicates of machine-shop jigs to ensure that the castings will set up accurately in automatic and multiple-tool machines. The castings then pass to the shipping department ready for despatch.

Methods of handling raw materials have improved and the horse and cart, which used to be seen in the foundry, and to a certain extent the wheelbarrow, have been replaced by conveyors, electric and petrol trucks, fork-lift trucks, stillages and trailers. These, besides speeding up the movements of castings, also provide off-the-ground storage for castings in between processes, instead of their being dumped out of barrows on to the floor and later picked up again.

Control and Development

The rigid control which has to be exercised at all stages of manufacture, the more elaborate equipment, the seriousness of any breakdown in a mechanized plant, have resulted in many more technicians being employed to-day than formerly. In addition, the developments and new ideas which are

FIG. 6.—*Lowering the Furnace Bell in a Lee-Wilson Annealing Plant for Malleable.*

being brought out and the need for every operation to be constantly studied to see how efficiency and productivity can be increased have made it advisable to have technicians who are not tied up in the daily routine of the foundry and process departments, but are free to study operations and layouts without being disturbed. This increase in scientific control, elaborate equipment and development work has considerably widened the prospect for advancement of young men entering the industry with engineering training. Many firms have planned courses for young engineers which cover all departments in the works over a period of two or three years. In addition, the National Foundry College, the National Foundry Craft Training Centre, the Institute of British Foundrymen, the local technical colleges, and the British Cast Iron Research Association now provide excellent facilities for the training of young men in foundry techniques.

The malleable industry has also benefited by individual foundries' research work, the co-operative research work at the British Cast Iron Research Association, the research carried out by suppliers to the industry, and the dissemination of knowledge under the ægis of the Institute of British Foundrymen, the FOUNDRY TRADE JOURNAL, and the American and Continental technical Press.

Working Conditions

The hours of work at the beginning of the century were 54, and in some foundries no fixed hours were worked. In one company those who averaged 51 hours out of 54 hours during the six winter months, excluding illness and including the opportunity of working extra hours near the end of the period to make up their average, were given a week's holiday with pay at Whitsuntide. Considerable progress has been made in an endeavour to improve working conditions and to meet the recommendations of the "Garrett" report. The installation of modern heating and ventilation equipment, the suppression of dust, the availability of protective clothing, the extension of first-aid and medical facilities, the building of changing rooms and showers, and new canteens, have received much attention.

During the course of half a century the good feeling between management and workpeople has continued unabated. It was in 1893 that the workpeople of one foundry presented an illuminated address to the chairman:—

> "... being desirous of recognizing in some small way the good feeling which has so long existed between yourself and those employed by you ... as an employer you have ever desired to promote our welfare ... our relations have been singularly free from disputes and the good feeling and justice which has characterized your treatment of us has been the medium of promoting the harmony that exists. ..."

And in 1950 a later generation presented an illuminated address to the chairman:—

> "... being anxious to recognize the good relations which have existed during the past 21 years between yourself and those employed by you ... we assure you of our continued loyalty and support. ..."

The progress made in the industry during half a century has been considerable. Improvements in equipment and methods of operation, in pattern-making, moulding, coremaking, melting, cleaning, annealing, fettling, straightening, and in the provision of amenities have been greatest during the latter 25 years, and there is no doubt that the industry is fully alive to the necessity of continuing to make progress.

Materials Shortage

Unfortunately, during the last few years, and particularly at the present time, progress has been hampered by the acute shortage of pig-iron and scrap, the difficulty of obtaining iron of the desired composition, the scarcity of coal and coke and their deteriorating quality, the amount of paper work necessary before applying for licences for modernization schemes, the difficulty in obtaining licences, and when granted the slowness in obtaining material and plant, and when completed the uncertainty of starting-up the new plant owing to shortage of pig-iron. All these items, coupled with the continued increases in costs of raw materials and transport, and the disorganization from electricity power cuts, has made the year in which we celebrate the 50th birthday of the FOUNDRY TRADE JOURNAL probably the most difficult in the history of the industry. However, it is up to all in the industry, managers, staff and workpeople, to continue to work as a team, tackle and overcome the serious problems which face them, and improve their efficiency like those pioneers at the beginning of this century solved their difficulties.

In conclusion, the Author would like to express his appreciation to colleagues in the malleable foundry industry who have provided him with information for this article.

Early Views on Annealing of Malleable

In a Paper read before the Birmingham branch of the British Foundrymen's Association and printed in the JOURNAL for January, 1916, p. 18, the Author, Mr. A. Harley, prefaces his remarks on annealing of malleable with the following statement:—

> The annealing of malleable requires a good deal of skill and experience, even when the hard metal is all it should be. There is no royal road to success in this process. Each man must work out his own salvation. The knowledge acquired from other people is no doubt useful, but the knowledge obtained from hard experience is the best.
>
> The following observations on annealing are not put forward, therefore, as infallible dicta. They are, however, the result of practical experience, and maybe helpful to some who are engaged in this most difficult business. A brief summary of the writer's views on the metallurgical process of annealing would run somewhat as follows:— "Any process in which equilibrium is established and maintained between the breakdown of the cementite and the diffusion of the carbon towards the exterior is likely to give satisfactory results."

Reading the rest of this article in the light of present-day knowledge, leaves one amazed at the omniscience then displayed.

50 YEARS

Co-operation Pays Dividends in Steelfounding

By **FRANK ROWE, B.Sc.**

Fifty years is a long time in the history of any phase of an industry, and many radical changes take place in outlook in that period. Steelfounding is no exception to the general rule, though it is difficult for those who have spent a good portion of the last fifty years in intimate contact with the industry to realize the extent of the change and progress without sitting back and trying to remember things as they were. The major value of a dissertation such as this is not to arouse nostalgia for the past but to see what, in past history, points the possible trends for the future. Which way have we come, and why, and what are the avenues for the future?

Steelfounding, as a commercial art, is not a very old one. Steel castings *per se* have been produced for well over 100 years, and Fischer's of Switzerland are credited with showing the first commercial range of small steel castings, produced from crucible steel, in 1845. Bochumer-Verein—the great German steel firm—were producing sizeable steel castings in 1851, but it was not until the advent of open-hearth furnaces in the 1860's and 1870's that steel casting became even an art practised on a fairly wide scale. The advent of the Tropenas converter in the 1890's greatly stimulated the production of the smaller steel castings and, at the turn of the century, an ever-rising tonnage of steel castings was being produced by this process. The arc-electric furnace introduced in the early 1900's did not cause anything like the furore that could have been expected had the future effects of this type of melting unit on the industry been then realized.

Arc Melting

The outbreak of war in 1914, with its subsequent enormous demands for steel castings, stimulated the growth of electric-furnace melting, largely because of pig-iron shortage at a time when 50 per cent. pig-iron was considered essential for good Tropenas operation. Early experiences of arc-furnace melting for foundry purposes were often hair-raising and disastrous. Because of the relative simplicity of acid open-hearth and Tropenas-converter operation, the snags and pitfalls of the electric furnace were not anticipated. In fact, in the period 1915 to 1920, many electric furnaces which had been put in with high hopes were abandoned with a sigh of relief as soon as pig-iron became once more reasonably freely available. Failure to master the intricacies of arc-melting practice caused more than one steel foundry to go into liquidation, and it is known that about 1920 at least two brand-new arc electric furnaces were never put into commission because of the unwillingness of two foundry managers to risk the uncertainties and teething troubles attendant on this new process of melting. Once techniques had been mastered and a clearer understanding of

Mr. Frank Rowe started his industrial career, after leaving Manchester Grammar School, ramming up lightening cores for cast-iron bedplates at Metropolitan-Vickers. After a spell in the light-casting bay (where his most enthusiastic efforts resulted in a pair of cast-iron sheep, St. George and the Dragon, and a rather cross-jointed cup, saucer, and spoon) the heavy bay and the pattern-shops endeavoured to teach him something of the ancient craft, including, in the latter shop, a rather wonderful seven-drawer mahogany-faced tool-box which is still extant. After reading metallurgy at Manchester University, there followed many years spent in iron, steel and bronze founding in various engineering works in this country, building a few new foundries and laboratories and remodelling old ones in the process before arriving at his present occupation of managing director of K & L Steelfounders and Engineers. Mr. Rowe has been a member of the Institute of British Foundrymen for thirty years, is a Constantine Gold Medallist, a Liveryman of the Worshipful Company of Founders, and immediate past-chairman of the British Steel Founders' Association. His services are often in demand for Government and other committees where foundry matters are concerned. His hobbies are (according to his wife) eating and drinking his way through Europe and stocking his cellar with more claret, burgundy and hock than, at his modest rate, he can ever hope to consume.

FIG. 1.—*Modern Air-less Shot-blasting Equipment which has speeded-up Production and eliminated many of the Less-efficient Plants in Steelfoundry Cleaning Operations.*

the metallurgical reactions obtained, the growth of arc-electric melting, with a basic lining for steelfounding work, proceeded steadily despite considerable progress in the art of operating Tropenas converters. The reasons for this are many. The Tropenas converter, as a producer of liquid steel for foundry purposes, has many advantages, some of which have to be sacrificed in turning over to arc-furnace melting.

Decline of Tropenas

The relative costs of arc and Tropenas melting have tended to widen since the 1910 to 1920 period, when Tropenas melting was at its peak. A chart of electric-power costs and pig-iron and coke costs in the industrial areas since 1910 shows one of the major reasons why electric furnaces have tended to become most favoured when new or replacement plant has to be considered. True, the Tropenas furnace has that greatly desired characteristic of " little and often " and the pig-iron content of the cupola charge can be greatly reduced by skilful technical operation, but the increasing scarcity of low-phosphorus steel scrap of the ideal configuration for cupola melting, together with the increased need for lower sulphur and phosphorus steel than the Tropenas can economically and regularly produce, has tended to act to the disadvantage of this most useful type of steel-melting plant. Whether the stage will ever be reached, as has happened in American steelfounding practice, where now less than 2 per cent. of the steel melted for steelfounding is Tropenas produced, is problematical, as the relative economics and material availability are somewhat different, but the tendency towards the same end is apparent.

On electric-arc furnaces, the most striking development of recent years, apart from refinements such as swing roofs, improved automatic electrode control, and rammed linings, is the power input per ton of capacity. It seems hard to realize that the early electric furnaces had only a power input of 200 kva. per ton, whereas to-day, power inputs of 800 to 1,000 kva. per ton are becoming commonplace. The innovation of oxygen blowing, as a regular method of carbon reduction after melting down, has further speeded the output-per-hour of electric-arc furnaces and reduced the high capital investment for a desired output.

The 1930's saw the commercial introduction of high-frequency induction melting for steel casting, particularly for small intricate castings in alloy steel, and this method of melting resulted in the almost complete abandonment of crucible melting. Though the actual tonnage of castings produced from the

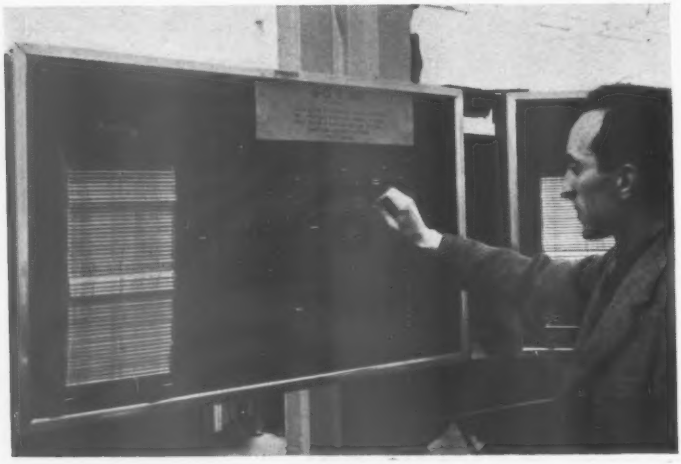


FIG. 2.—*Production Control is an Important Factor in utilizing Machines, Floor Space, and Men to the best Advantage. In Modern Steel Foundries the Work of each Machine is Planned in Advance to ensure that Boxparts, Patterns, etc., are ready when wanted.*

induction furnace does not look impressive, the value of castings made from induction steel is most important and constantly rising.

Moulding Sands

In no phase of steelfounding practice has the change and improvement been greater than in sand practice, and a large part of the improvement in quality, accuracy, and appearance of castings which has taken place has been due to these changes. Looking back, it does seem somewhat mysterious as to why the changes should have been so long in coming, since they are not largely due to outstanding scientific discoveries but more to patient experimentation and a dawning appreciation of the importance of moulding materials and techniques.

In the 1900's, and indeed for long after, green-sand was reserved for the smallest and most unimportant castings in this country. Even the 1920 edition of McWilliam & Longmuir's classical text-book on foundry practice dismisses green-sand moulding for steel castings in three lines with these words: " Only light castings are made in green-sand, and an ordinary mixture, as for iron, is used. Any of the red sands answer well, provided a suitable facing is dusted on." All but unimportant castings were moulded in " compo," for which each foundry manager had his special recipes in the little shiny black notebook which contained his most jealously-guarded trade secrets. Most contained some weird and illogical " special additions "—that little bit extra wherein the greatest value was supposed to lie. These were usually malodorous and unhygienic additions which savoured more of black magic than technical knowledge. Gradually, however, the use of naturally-bonded sands (and particularly Belgian sands) replaced the older mixtures, both for green- and dry-sand castings, with a consequent and valuable extension of the field which could be covered by green-sand. The beginning of the 1939 war gave a tremendous fillip to synthetic sands—i.e., pure silica sands bonded with bentonite—when supplies of Belgian sand were interrupted and, in steel foundries where close technical control is available and used, these sands are nowadays the first favourites for all but the extremely heavy castings.

Core Materials

Core-sands have followed a similar trend, and much progress has been made from the stage where horse-dung, cow-hair, and beer dregs were quite usual and considered essential ingredients to the sand mixtures. Fillers and binders for core-sands are nowadays of more savoury origin, and the skill of the organic chemist is more and more being used to secure the combination of properties desired. There seems little doubt that the organic chemist will play an ever-increasing part in sand chemistry, with the increasing development of synthetic-resin and other organic binders.

Moulding

Machine-moulding antedates commercial steelfounding by a good many years, and, whilst the developments have been many in the last fifty years, there have been few which are startling. Most are logical developments in size and performance, following, in the main, standard engineering developments. Dressing-shop practice, that inevitable major concomitant of steelfounding, has not, in general, made the progress that other phases of operations have shown. The almost universal use of pneumatic dressing tools has gradually grown since 1910, but no one should say that the last word has yet been said about their inevitability. They are terribly noisy, and they are the major source of such risk of silicosis as still exists in steel foundries. Great progress has been made in the preliminary cleaning of castings, where the sand-blast, and now for many years the shot-blast, has replaced the old rumbling barrel for small castings. The advent of the airless shotblasting equipment (Fig. 1) was a major step in cleaning processes, and the industry now appears to be on the threshold of a new era in cleaning and trimming steel castings with the advent of the powder-injected oxy-acetylene " washing torch."

Dressing of steel castings is a major cost in steelfounding. It is probably the most arduous job in engineering to-day, and no effort can be too great which will succeed in improving the efficiency, the safety, and the ease with which this job can be done. It is here, probably more than in any

FIG. 3.—*X-ray and Gamma-ray Equipment is commonplace in Steelfoundry Practice to-day. Either Prototype or Production Castings are regularly checked for Internal Soundness to maintain exact Control on Methods and Performance.*

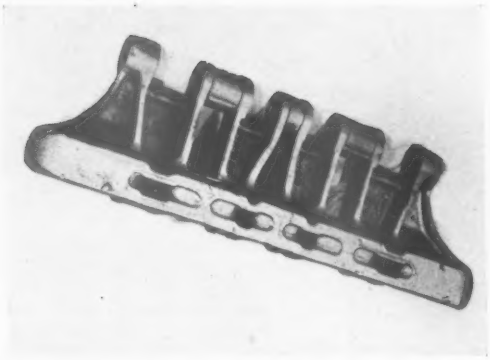


FIG. 4.—*Provided the Quantity of Castings required is sufficient to warrant Metal Patterns and Metal Corebox and Core-dryer Equipment, high Accuracy can be obtained with Modern Steelfounding Methods. The Heat-treated Track-link Casting illustrated, weighing* 40 *lb. and having an Overall Length of* 24 *in., is being made with a Maximum Variation of* 0.010 *in. on all Important Dimensions.*

operation, that the most desirable and fruitful field for further progress lies.

Technical Controls

Steelfounding is still in the transitional stage from an art to a precise science. The difficulties of securing not only a completely-sound casting but also a *series* of completely-sound castings from the same pattern by the same method are very considerable. The degree of permissible variation in the whole of the procedure by which a sound steel casting is made is extremely small—generally much smaller than in the founding of any other alloy. At the same time, the difficulty of complete standardization—particularly of metal condition (principally, temperature and gas content)—is great. This calls for technical control of a high order on raw materials, methods, and times of every detail of operation, and for constant testing and checking of the finished product (Fig. 2).

The gradual rise and extension of technical control, and the increasing application of the results of later scientific research, have been a notable feature of the last 50 yrs. Few steel foundries with pretensions to producing sound castings for important engineering duties are without the services of metallurgists and senior supervisory staff with a vivid appreciation for standardized operating conditions controlled on scientific principles. The extending field and greater general dependence on steel castings is due more to these factors than any other cause. Perhaps the scientific aid which has helped most in this quest for increasingly higher standards of performance is radiography. First installed in 1936 as a means of detecting unsoundness in steel castings, the increase in the number of foundries using radiography since then has been fairly rapid. Initially X-rays were used, then, with the increasing availability of radium, gamma-rays. Recently, the availability of isotopes from the Harwell atomic pile has greatly cheapened the cost of installation of a radiographic laboratory (Fig. 3).

This growing appreciation of the need for absolute standardization of method has led to most foundries installing a methods department, where careful records of successful moulding technique have been gradually built-up. The standards of precision and soundness now being offered by the steel-castings industry, and the greater working stresses of modern engineering equipment, have rendered it impossible to rely on the memory or individual idiosyncrasy of the moulder or floor-supervisor to put exactly the same sizes of heads and runners in exactly the same place on the same casting every time it is made. Yet such is absolutely necessary, together with identical casting temperature and casting speed, sand composition and mould hardness, if repetitive castings to an initially high and satisfactory standard are to be obtained (Fig. 4).

FIG. 5.—*Rapid Growth of Mechanical Aids in Steel Foundries is a Feature of Recent Years. By the Comparatively-simple Device Illustrated, One Man is doing Work which formerly needed Two Men, plus the Services of an Overhead Crane.*

Productivity

The steelfounding industry is proud to have blazoned the trail towards higher productivity, but those who know the industry best are not surprised that it should have done. The first team to travel to the United States under the auspices of the Anglo-American Productivity Council set a standard in its Report which has since been many times equalled but never excelled. The industry would be the last to claim (indeed it would be the first to deny) that all is right with the productivity of British industry. It is as conscious as any—possibly because of the distance it has travelled in the last ten or fifteen years—of the tremendous scope for vast improvement in its own field. Whilst only too painfully aware of the difficulties of securing the improvement it sees possible because of general attitude, long delivery of modern plant and present fiscal policy, it has little intention of allowing these obstacles to prevent constant progress towards fewer man/hours per ton in every phase of steel-foundry practice (see Figs. 5 and 6).

Working Conditions

The steel foundry can never have the working conditions of a corset or cosmetic factory. It is, and always will be, in the main, a he-man's job, where pride of creation of worthwhile and really essential products gives that spiritual satisfaction without which no man can give of his best. Those who remember the general standards of foundries 30 or 40 years ago know that the passage of time has led to a marked and most worth while improvement in working conditions, though much still needs to be done.

The preoccupations and restrictions of two major wars in 50 years have not been conducive to that degree of improvement that those who have spent all their working lives in foundries would have liked. But certainly, in the last six years, most steel foundries have moved as fast as shortage of labour, materials, and permits would allow. There is no more valuable member of the industrial community than the foundry worker, and it is no more than his due than that employers should bend every effort to make his working conditions the best that are possible, having regard to the nature of the job. In this direction the British Steel Founders' Association, through its own committees, its Research Division, and its willing help and interest in other bodies studying similar problems, regards the improvement of standards of building construction, heat, lighting, ventilation, dust-suppression and removal, and adequate washing and toilet facilities as one of its major preoccupations, and the standards now being achieved by several of the leading steel foundries show, in a practical manner, the depth of their interest. There can be no permanent satisfaction until everyone feels that everything practicable that can be done has been done to remove unnecessary unpleasantness from what, in any case, is bound to be an arduous job (Fig. 7).

British Steel Founders' Association

No review of the last half-century of steelfounding could be complete without mentioning the tremendous part played by the British Steel Founders' Association. Most industries have trade associations, and these play a more or less significant part in the general welfare of the industry. These vary from mere statistics-collecting or price-fixing bodies to the ultimate ideal of what a trade association should be, as represented by the B.S.F.A. Started in its original form in 1934, pretty well at the depth of the trade depression, it has progressed in 17 years to an organization which interests itself in everything except the most specialized phases of the steelfounding industry. By a free and exhaustive exchange of experience between its members, by its varied committee work, and by its Research and Development Division, it is rapidly becoming the envy of the steelfounding industries in other countries. It is a far cry from the days when competitors in the industry had hardly been known to get beyond each other's front offices and when membership of technical societies by junior personnel was frowned on by boards of steelfounding companies lest their jealously-guarded trade secrets were unwarily disclosed.

FIG. 6.—*Metallurgical Progress in Steel Foundries has involved More-elaborate Heat-treatment Facilities, both to Speed-up Production and to obtain the Highest Physical Characteristics in the Various Grades of Steel. The Illustration shows one of a Pair of Rotating-hearth Electric Furnaces in which One Man can Quench and Temper over 2 tons of Quite Small Castings in an 8-hr. Day.*

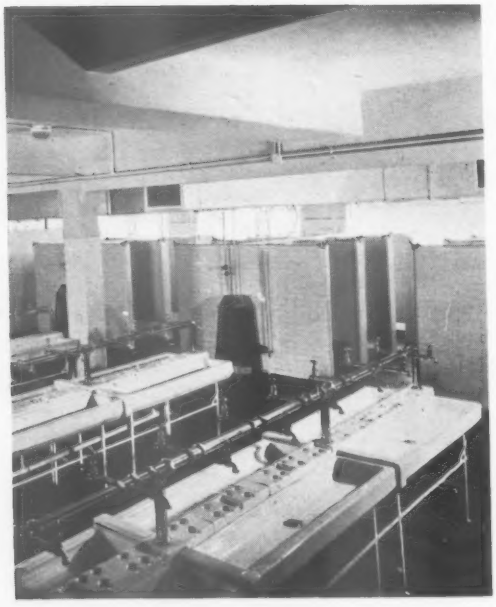


FIG. 7.—*Extensive Progress has been made in Recent Years in the Provision of Washing and Shower-bath Facilities for Steelfoundry Workers.*

It is a trite and platitudinous saying that all the brains can never be in one set of heads, but even to-day, in certain industries, whilst it may be accepted in theory, it is not acted on in practice. Nevertheless, the majority of firms in the steelfounding industry have convinced themselves that only by throwing their own efforts into the common pool can they hope to benefit from the experience of others. In no industry can it be more true that the welfare of one is the welfare of all, and that to assist the perhaps less-experienced steelfounder is not only to assist the industry, but also, in the long run, to assist oneself. Every steel casting lost to a competitive material through inadequate quality or uneconomic price is a loss not merely to the individual company, but to the industry as a whole. Each steelfounder is poorer because of it.

It is true that within the industry there are still a few steel foundries not members of the B.S.F.A. These are either the rugged individualists whose disbelief in the value of co-operation one must deplore, or those to whom steelfounding is but an ancillary [and generally money-losing] operation in their whole field of operations. The industry has been immeasurably strengthened, and its prospects for the future brightened, by the enlightened co-operative spirit increasingly shown in the last 15 years. The comradeship engendered by the exigencies of war-time troubles and production has been built-on and enlarged in the ensuing six years.

Present Situation

Steelfounding to-day, because of the unprecedented demand for capital equipment embodying steel castings and the rearmament programme, is working under a tremendous overload. This is, in the opinion of the level-headed and far-seeing companies, a mixed blessing. While it is perhaps satisfying to know one's order-book is likely to be full for three or four years ahead, there is always the danger of complacency regarding the urgent task of maintaining and increasing the firm's competitive efficiency in the world's markets.

The long delivery-times for new plant, the urgent pressure of day-to-day difficulties with shortage of materials and labour, the confusion and time-aborbing worries of the continued march of inflation are apt to leave all-too-inadequate time for patient study by those in control of forward trends in plant layout and technique developments. Again, a situation such as the present may lead the less-efficient foundries to ignore the dangers they are likely to face when demand once more returns to normal. The seller's market for steel castings will not last for ever, and deficiencies of quality, accuracy, and finish in the less-efficient foundries will militate against their obtaining their normal share of the post-boom market.

Future

To-day one can be much bolder about the future of the steelfounding industry than one could have been 20 years ago. The great advances in quality, technique, and alloy castings have widened tremendously the field for the economic use of steel castings. Again, in the international field, the competitive standing of the British steelfounding industry is higher than it has been since 1914. Given the same active pursuit of higher productivity, the same activity in technique development, and the same degree of capital investment that have animated the industry in the last five years, then such weak spots as still remain in the industry's economy will disappear in a reasonably short time and result in a British industry which supports to the full the competitive efficiency of the engineering industry, even in times when home and export markets will face up to the strongest international competition.

It has not been an unsatisfactory 50 years for progress. Given peace and a greater degree of international understanding and partnership, the next 50 years should be equally expansive both in volume and technique and the "dividends" secured by co-operation will be even further enhanced.

As a matter of historical record, the first electric steel melting plant was installed in 1911 in the works of Lake & Elliot of Braintree. It was a Heroult furnace, had a capacity of two tons, and used two 14-in. dia. electrodes. The total of the sulphur and phosphorus content in the steel produced was after a year's working reported as running at less than 0.03 per cent. This furnace gave yeoman service through several decades. It was soon followed by installations at Edgar Allen's and Firth's of Sheffield.

Neath Abbey Iron Works—19th Century Founding

In a special issue devoted mainly to historical reviews of foundry practice over the last 50 years, it is interesting for the sake of comparison to go back still further and examine the sort of foundry business carried on in the previous century. For the account below, we are indebted to Mr. T. R. Harris who has carried out extensive research into historical documents of that time. He is a member of the Institute of British Foundrymen, and has been a regular contributor to the JOURNAL *for over 20 years.*

To provide some of the castings urgently required by the Cornish mines, a foundry was established in 1791 at Perranwharf, between Truro and Falmouth, by a group of businessmen, from the latter place, who were interested in mining. In the following year the same men secured a lease of the Neath Abbey Iron Works in South Wales, thus enabling them to produce some of the heavier castings needed for the large pumping engines then being erected at a number of the mines. A reference to this is to be found in the Boulton and Watt letters. Writing from Truro on September 22, 1792, James Watt states that "Messrs. R. W. Fox & Co. of Falmouth have ordered an engine for blowing iron furnaces at Neath Abbey. The castings and the cylinders are to be done at the Dale, and pipes and small castings at their new foundry here. The hammered iron work is all to be done here or in Wales . . ."

Periodically meetings of the shareholders in Neath Abbey Iron Works were held at Perranwharf, one such meeting being held on August 23, 1796, when those present were G. C. Fox, George Fox, Peter Price, Samuel Tregellas and John Gould, all Quakers. Although advertised for sale in 1817, the works continued under the Quaker owners until 1874, when they were closed down, but were re-opened in the following year and continued until 1885-86.

Early Equipment

From the advertisement of November, 1817, one learns that at this time the works consisted of "Two Blast Furnaces ready to work at short notice, a very extensive foundry well furnished with all necessary implements and capable of making the largest castings, a powerful boring mill, worked by water, with complete apparatus for boring and turning all kinds of castings. . . . Commodious buildings now employed in making steam engines, on the most approved plan, being furnished with an excellent steam engine turning lathe and all other necessary apparatus. . . ." Some peeps into Neath Abbey Iron Works can be caught from a perusal of the biography of Edwin Octavius Tregellas. The son of Samuel Tregellas, young Edwin was left motherless at an early age and tells that "in 1819 Uncle and Aunt Price (she was our father's eldest sister) came into Cornwall and kindly proposed to take me to live with them at Neath Abbey. . . . In the ninth month I went to work in the carpenter's shop . . . my brother Nathaniel came to the Neath Abbey Iron Works as a clerk in First Month, 1822 . . ." In the summer of 1823 Tregellas was engaged in engineering work, on behalf of Neath Abbey, at Camborne for several weeks and subsequently he was frequently employed in superintending work and in securing orders.

In 1831 disturbances and strikes were rife in South Wales. Writing in his journal on June 7 of that year, Tregellas states: "These are momentous times. Riots at Merthyr. Cavalry constantly passing, and reports of many persons being killed. This has been a day of considerable excitement. I felt it required of me to address our workmen. . . Our men at the Neath Abbey Iron Works were assembled in one of the large smiths' shops; cousin Joseph T. Price, my brother Nathaniel, the clerks and I went to them . . . from that day forward, never again was any semblance of insubordination apparent. The men quietly dispersed, and we heard no more of the strike." Later in the same year, acting on the advice of his friends, E. O. Tregellas severed his connection with Neath Abbey and commenced on his own account as an engineer. His brother Nathaniel remained with the firm and recently the writer of this article examined a number of letters written by him to his friends in the West Country.

Pig-iron and Hot-blast Cupolas

On August 23, 1836, he writes: "One of our furnaces is making iron with hot blast of excellent quality for mixing with a large proportion of old castings and hard iron; are you disposed to purchase 100 tons on trial, if so we will put it on board at £6 15s. per ton for 6 month acceptance. Your order will oblige . . ." A week later he writes: "We are obliged by your order for 100 tons of pig-iron—it is ready any day. We should have been glad to have taken some Millets sand from you but we are not likely to want for a considerable time, our consumption of it is small . . ."

In March, 1837, Tregellas is again offering pig-iron and says, *inter alia*: "We wrote you on the 18th ult. offering iron at £5 per ton since which a fall of 10s. has taken place and we must follow, however reluctantly. Will you take 100 tons of us—the quality is good, made all from mine, no cinder to make weight, we find a great difference in this respect . . ." Later in the same year another letter deals with pig-iron of the Neath Abbey manufacture. "We should much like," writes Tregellas, "to send you 50 tons of our foundry pig-iron we are now making with a proportion of anthracite coal which makes it surprisingly strong and very fluid, it melts well and the writer can recommend it to your notice as very suitable for founders . . ." Again, in June, 1838, the merits of Neath Abbey pig is commented on as follows: "We have lately commenced smelting our iron stone with a proportion of our Pwlfuron Stone Coal or Anthracite and find that the quality of the iron is much improved thereby as regards strength and fluidity—it melts also quite as well as *cold* blast iron, and we think you will find it suit your purpose well and we could ship 50 or 100 tons at £5 for No. 1—£4 15s. No. 2—£4 5s. No. 3 for 6 months acceptance. We have within the last week tried *calcined* stone coal with coke of bituminous coal half and half for smelting in a cupola, and we find that 8 lb.* of each will melt 1¼ tons of iron and improve the quality—it is grey and long lived, and will run the thinnest castings. The Coal Co. sell this stone coal at 9s. per ton and if you are disposed to try it, we will give you a description of how we coke it. We use heated air in our cupola and pay £8 per annum patent right, heating the air in a vessel at the top of the cupola—of which we will send you a sketch if you like. We hope you will try our iron and waiting your order. We are, Yours Truly, Neath Abbey Iron Co., p.p. Nath. Tregellas."

* This figure is difficult to interpret—Editor

What of the Future?

Although the business of the JOURNAL is to mirror the achievements of the times and not indulge in flights of fancy in forecasting the future, it is impossible to let this special opportunity go by without a modicum of speculation, if only to point the contrast with past and present. The obvious way, of course, is to extrapolate from the trends to-day and yesterday. Another way is to give the imagination full rein, remembering that the present often bears little relation to the past. The first method might be described as evolutionary, being typified by the production of spheroidal-graphite cast iron—a hybrid "issue" produced by "crossing" the features of malleable and grey cast iron. The second method of crystal-gazing can be termed revolutionary—where an "atom bomb" of the foundry world will, as it were, produce bricks without straw or castings without sand. It might be germane to examine the sort of thing to be visualized in each of these respective avenues of approach.

Evolutionary Changes

Trends of yesterday and to-day in foundrywork can be analysed and followed-up for the future as follows. Foremost there is rehabilitation of foundries and, concurrently, the splitting-up of skilled moulding (apart from very large jobbing work) into clearly-defined mechanizable operations, to be performed repetitively by unskilled operatives. Then there are detail improvements in melting, moulding, casting and finishing processes. The water-cooled basic cupola with a hot-blast arrangement much on the lines of a miniature blast-furnace and arranged for continuous melting over a period of months would seem a logical development. For the non-ferrous side, holding furnaces with infinitesimal heat loss would seem to offer possibilities of continuous metal supply—each being replenished by bulk supply every week or so with refined metal. Certainly atmospheric exclusion from melting processes where desirable will be accomplished, as will a great improvement both in insulating and heat and slag-resistant refractories. No doubt, electrical melting furnaces will be within reach of the jobbing brass-founder of the future, and reduction in number of alloy specifications or, conversely, in specialization by founders in one type will follow. Steel melting, too, will become cleaner, probably with a leaning to H.F. furnaces.

Moulding will undoubtedly see extensions of the "C" process and investment methods, parallel with the growth of permanent-mould practices. It is not unforseeable that the huge tonnage movement of sand per unit of castings, apparent nowadays on mechanized plants, will soon be a cause for derision. No doubt "hand" skills will still be required among some operatives in the foundry, but in even the jobbing sections these will change to mental skills at such things as work break-down, pattern and mould making, and skill in control and dovetailing of operations. No longer will a casting be admired because it is large and took a long while to make, rather will it be the reverse—the questioner will ask "Surely it could be made another way in fewer man/hours" and the answer will be found, impalatable though it may prove.

Precision in the foundry of to-morrow will no longer be the sole target of the investment foundry. Unbelievable accuracy in every foundry will derive from the discarding of outworn methods and equipment. Accuracy in patterns to "thousandths" will be matched by the ultimate casting and countless machining operations will be obviated. Already one can visualize hundreds of castings now machined which ought not to be, if given just that slight extra precision.

As to finishing operations, it will be clear that, far from becoming more highly developed, they will for the general run of castings largely become redundant. Git-cutting and trimming machines will still be required, however, as will some continuous plants to "dissolve" adhering sand or to clean, anneal and rust-proof or enamel in one operation. Composite castings will be commonplace, with bearing surfaces or special faces of expensive alloys cast integrally.

Revolutionary

A single cataclysmic change, it is postulated, could put all preconceived notions of foundrywork on a par with the Stone Age. This having been accepted, the "sky becomes the limit," but it is a necessary hypothesis for this present excursion into phantasy to select some half-way house. Without going so far as to visualize a nuclear-energy-powered foundry or, still less, an age (God forbid) in which all foundrywork is redundant, the invention of a new energy source within our lifetime is selected as a not-too-difficultly-envisaged event. This may be nuclear, cosmic, planetary or bacteriological, but whatever its nature, one can assume one of its immediate effects would be to place super-abundant electrical energy at the foundryman's fingertips. What would he do with it?

To start with, metal in all foundries would have to be literally "on tap" from reserve furnaces, these being supplied by tank-car from refineries. Intermediately, ironfounders might still prepare their own metal in the baby blast-furnaces but it is certain that their receiver would be H.F. heated. It therefore behoves furnace and refractory research workers to get busy immediately on furnaces, lagging and lining materials as well as the "tap" design so as to be ready by the time the rest has come to pass. Metal supply from a pipeline for pouring forms an obvious corollory and other possible variations are likewise apparent.

A second prognostication would be a continuous casting machine (several times already attempted). This would be one in which patterns pass from a magazine at one side, metal enters at another and moulding material at a third; when the operator presses buttons on the fourth side, the boss looks on from above and the casting drops like an egg from below. Shell moulds, reinforced as required, would be necessary and maybe the pattern would be invested by spraying the mould material. Metal would be run from the "tap" and consolidated by supersonic vibration or pneumatic pressure, doubtless quick cooling could be arranged by an induced refrigeration. The whole foundry would resemble a bakery in its cleanliness and atmosphere and the labour requirements would be such as no longer to constitute a "headache."

No doubt, however, in the summation, the foundry industry will progress much on evolutionary lines, always with the proviso that anything can happen—even to man-made cataclysms. One could give the imagination full rein in the manner of the foregoing but all to little purpose if the lesson were not stressed—that foundrywork is not static that *one* research discovery (however small) rightly *applied* can bring immeasurable result in its train. It is this psychic discernment as to the application of research which is of pre-eminent value as an investment for the future, and in which British foundrymen must maintain themselves as second to none.

FOUNDRY TRADE JOURNAL

EST. 1902

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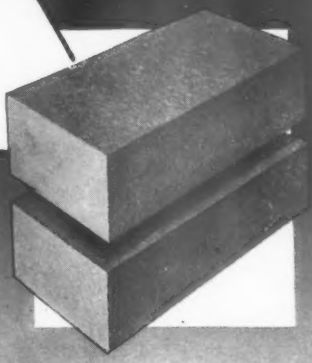

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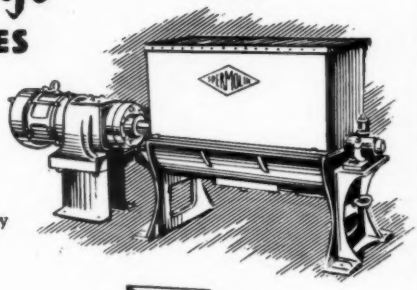

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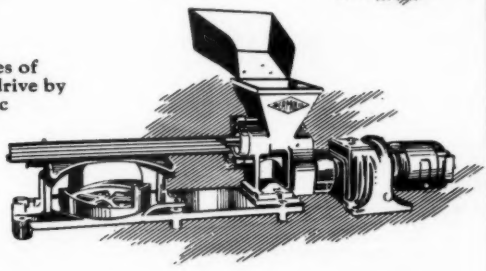

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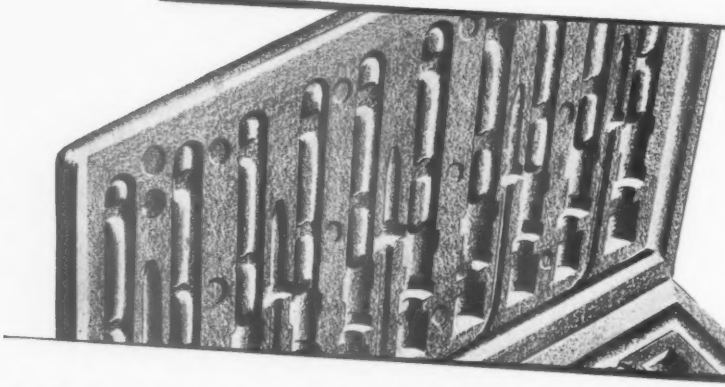

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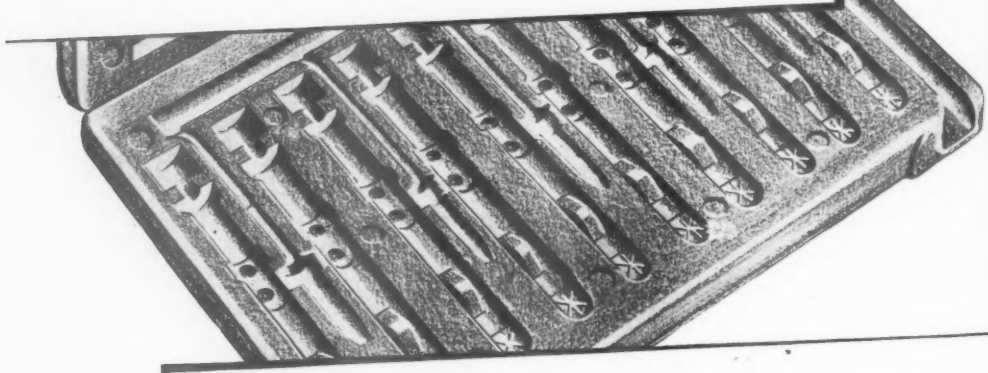

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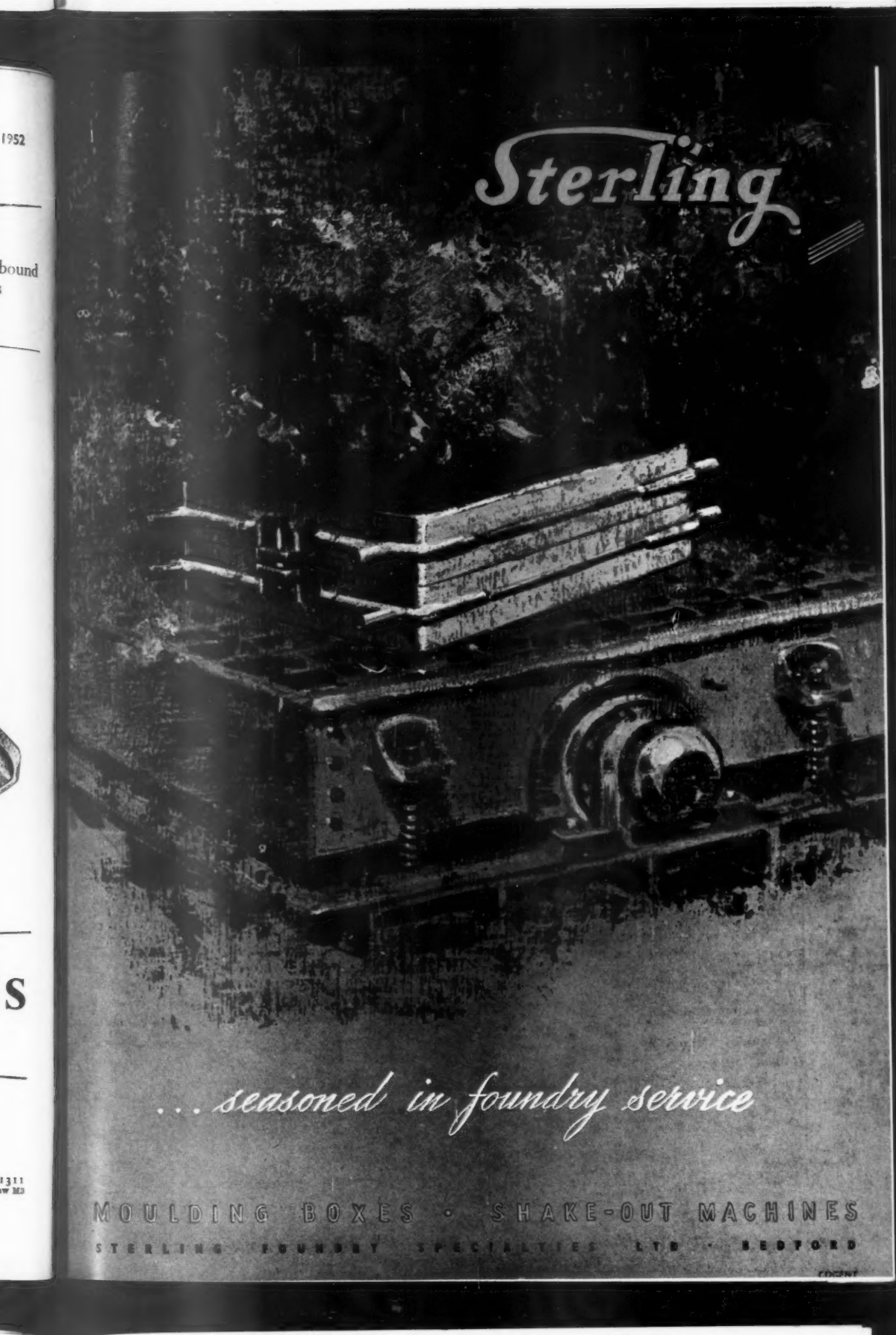
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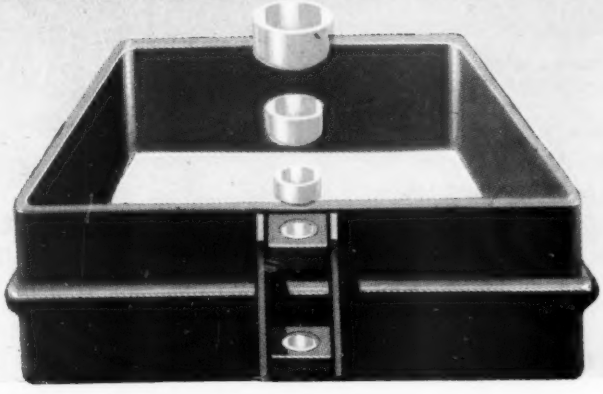

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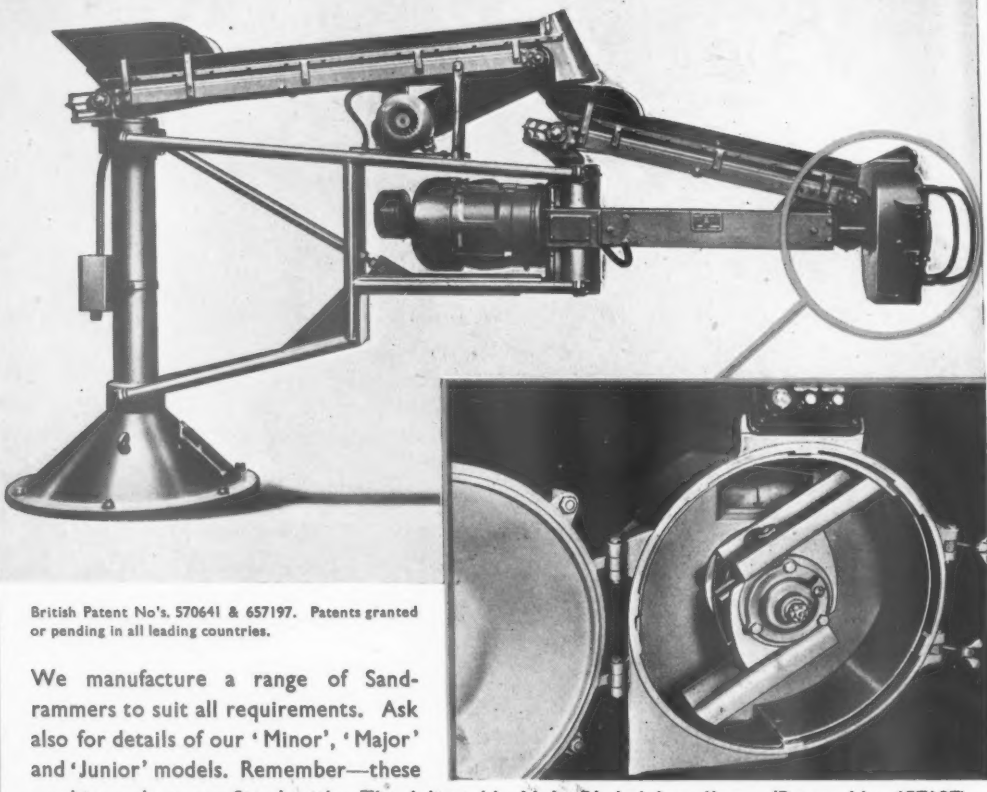

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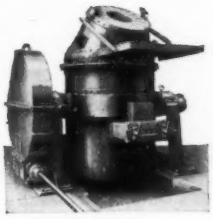

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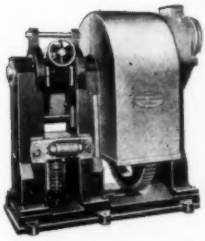

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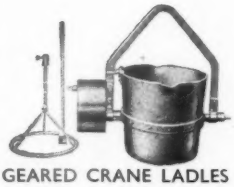

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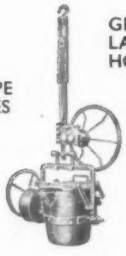

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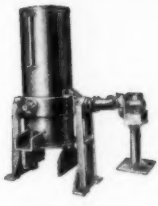

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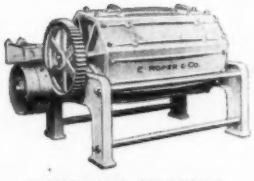

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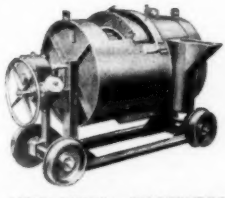

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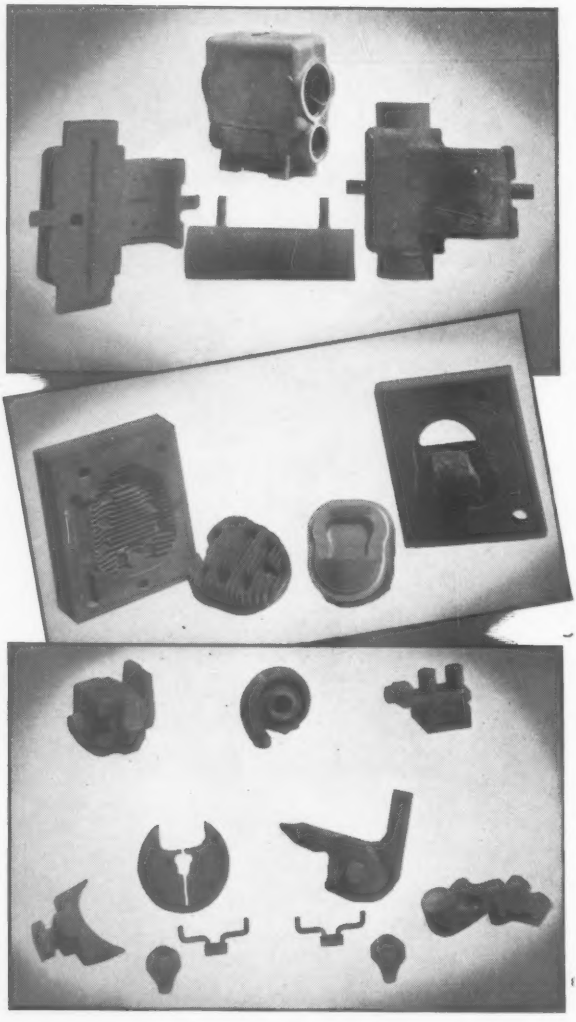

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Kordek products are made to work in combination with Oils, or Resins, or other types of dry bond additives, and certain grades are themselves impregnated with Oils and Resins ready for use. We reproduce on this page, photographs showing a variety of cores made with G.B. Kordol which is an Oil impregnated binder requiring nothing more than mixing with moist sand. The outline of each core is distinctive in sharpness of detail and will be reflected in castings of equal distinction.

We are indebted to Marshall Castings, Ltd., Birmingham, for permission to reproduce the photographs taken in the Foundry where G.B. Kordol is employed exclusively in all core production.

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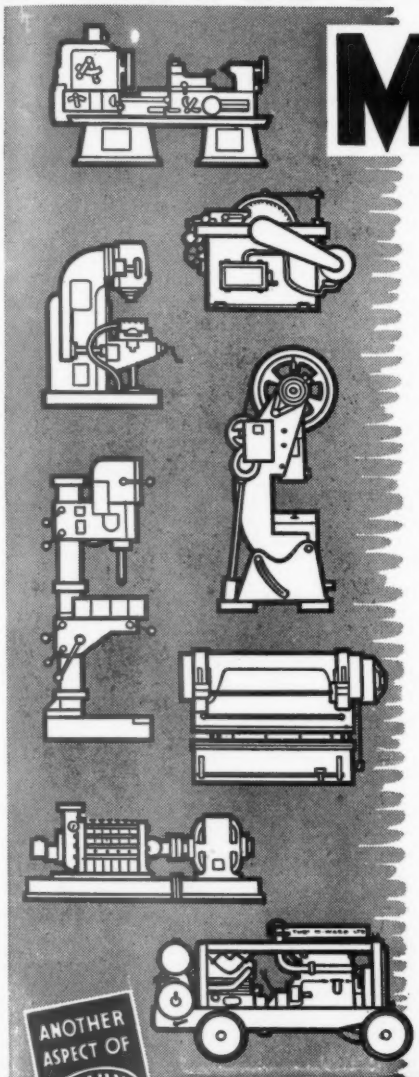

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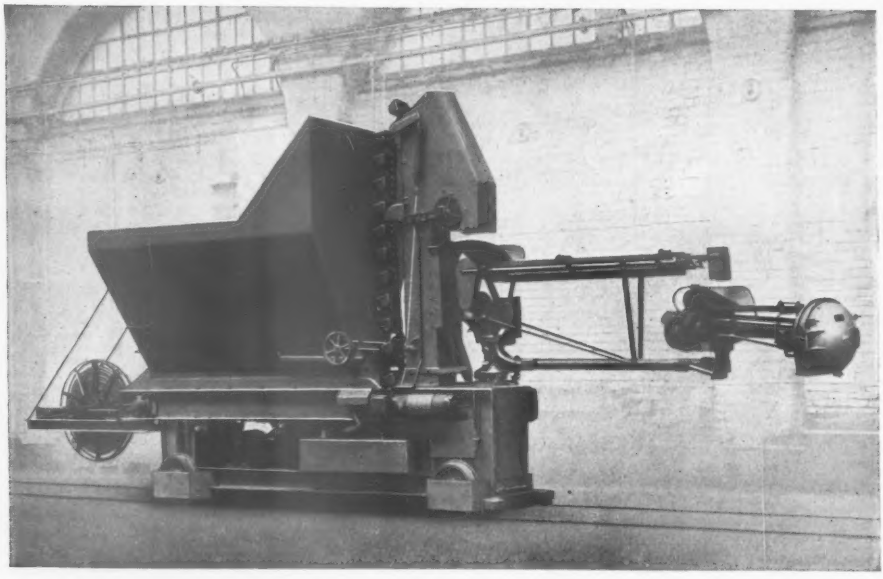

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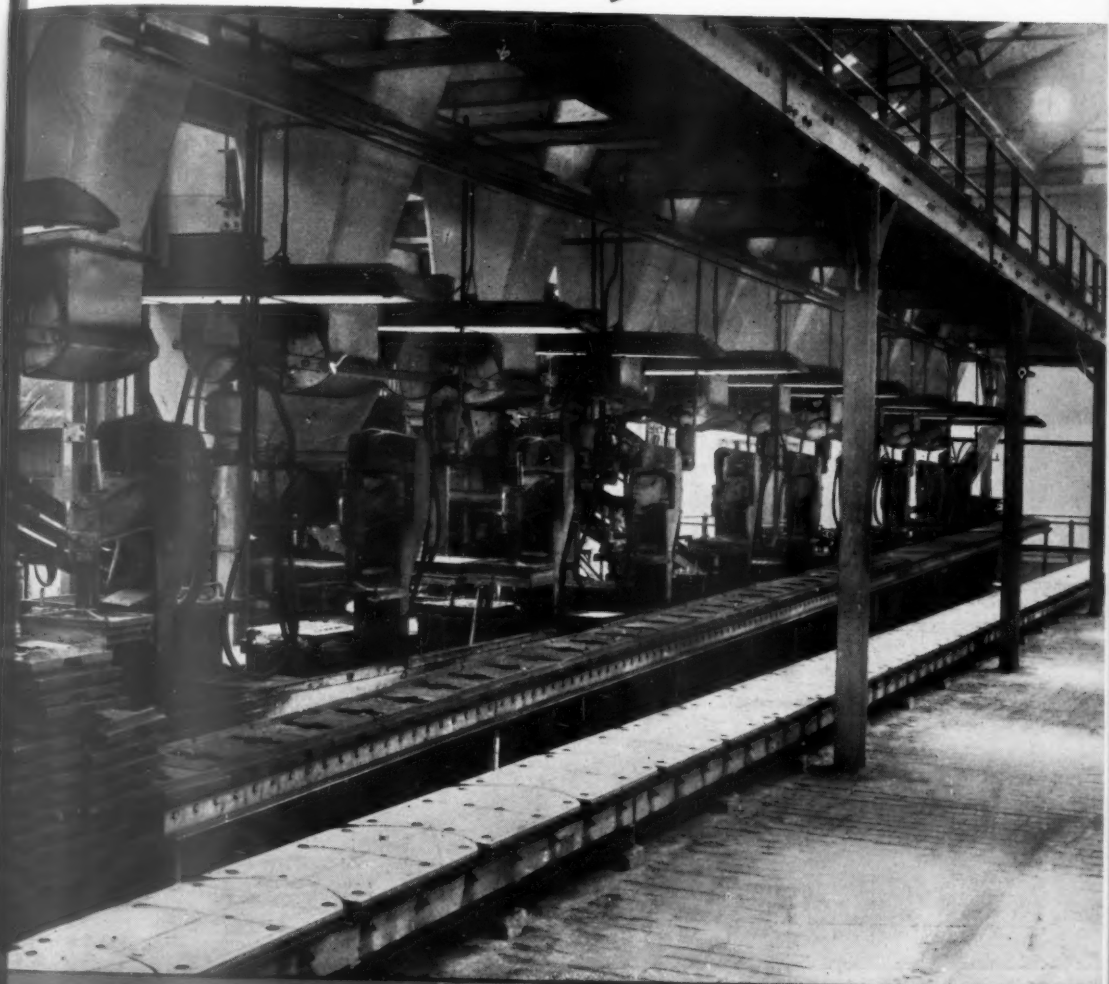

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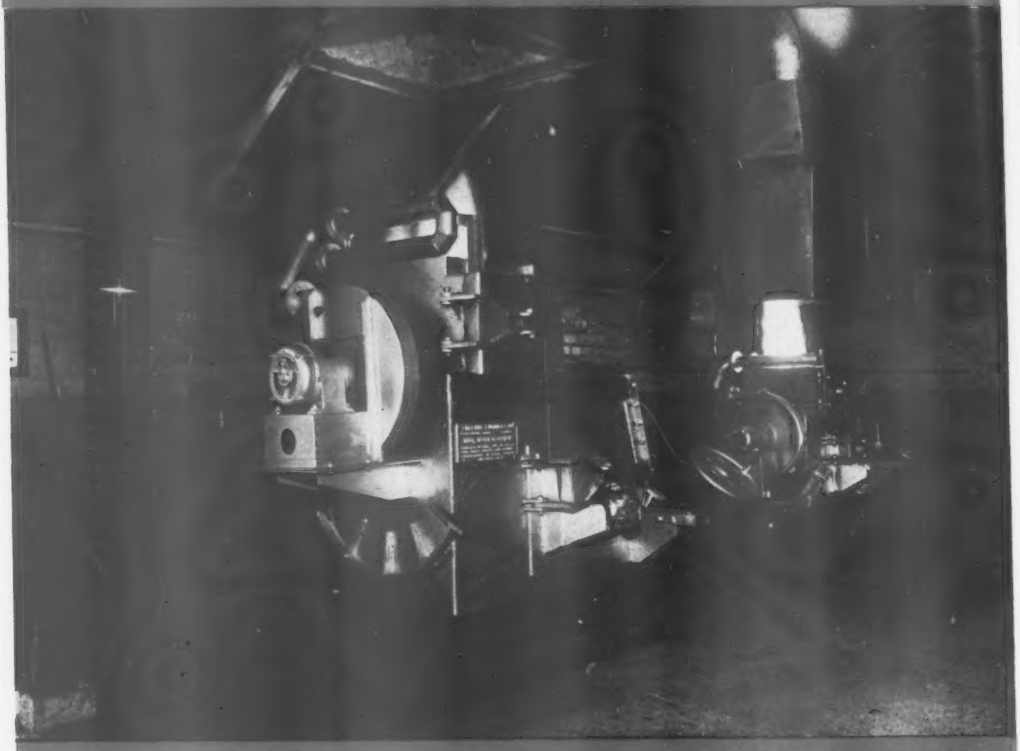

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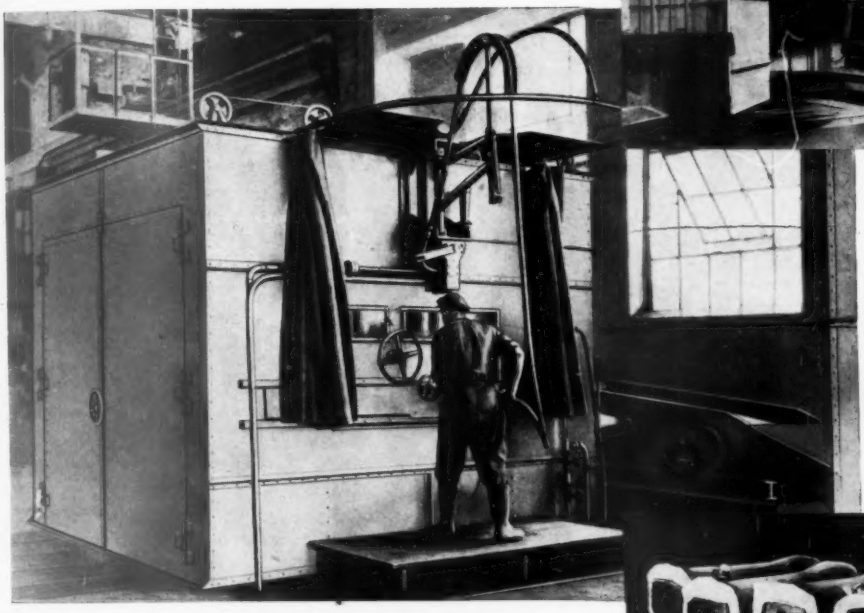

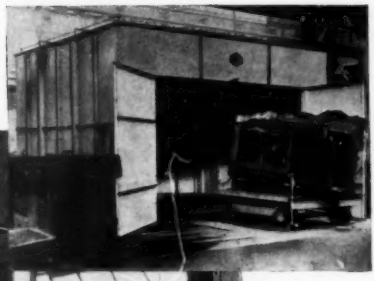

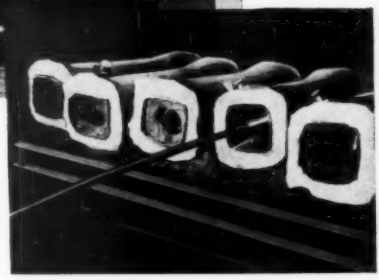

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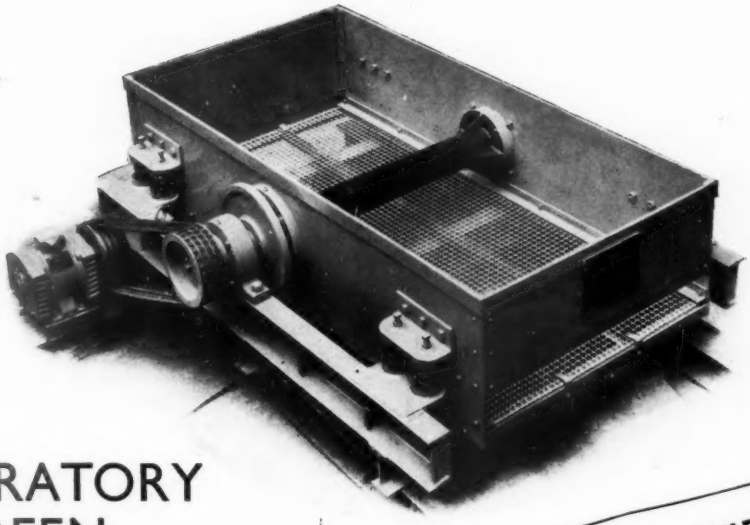

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SECTIONS

Burnley : H. Buckley, 33, Newcastle Street, Burnley. *Cape Town* : S. Wade, P.O. Box 46, Salt River. *East Anglia* : L. W. Sander, Lake and Elliot, Limited, Braintree, Essex. *Falkirk* : A. Bulloch, Jones & Campbell Limited, Torwood Foundry, Larbert, Stirlingshire. *Scottish-North Eastern* : R. Leeks, Alexander Shanks & Son Limited, Arbroath. *Slough* : P. Hoesli, Light Production Co., Ltd., Slough, Bucks. *West Wales* : J. D. F. Yuile, 85, Vicarage Road, Morriston, Swansea.

BRITISH STEEL FOUNDERS' ASSOCIATION

Chairman : **T. H. Summerson**, Summerson's Foundries Limited, Albert Hill Foundry, Darlington, Co. Durham. *Secretary* : **Robert Barber, A.C.I.S.**, Broomgove Lodge, 13, Broomgrove Road, Sheffield, 10. 'Phone and 'Grams : Sheffield 63046.

RESEARCH AND DEVELOPMENT DIVISION

Chairman : **F. N. Lloyd**, F. H. Lloyd & Co., Ltd. *Director* : **J. F. B. Jackson, B.Sc., A.R.I.C., F.I.M.** *Secretary* : **Robert Barber, A.C.I.S.**, Broomgrove Lodge, 13, Broomgrove Road, Sheffield, 10. 'Phone and 'Grams : Sheffield 63046.

ASSOCIATION OF BRONZE AND BRASS FOUNDERS

President : **W. R. Marsland**, Newman, Hender & Company, Limited, Woodchester, Glos. *Secretaries* : **Heathcote & Coleman**, 25, Bennetts Hill, Birmingham, 2. 'Phone : Midland 2901. 'Grams : "Clarify," Birmingham.

LIGHT METAL FOUNDERS' ASSOCIATION

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President : **W. E. Aske**, William Aske & Co., Ltd., Waterside, Halifax. *Secretaries* : **Peat, Marwick, Mitchell & Company**, 94/98, Petty France, London, S.W.1. 'Phone : Abbey 7515. 'Grams : "Crusades, Sowest," London.

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President : **Dr. J. E. Hurst, J.P.**, Bradley & Foster, Limited, Darlaston, Staffs. *Chairman* : **S. Hallsworth**, Metal Porcelains Limited, Cornwall Road, Smethwick, 40, Staffs. *Secretaries* : **John Gardom & Company**, Ripley, Derbyshire. 'Phone : Ripley 136.

COUNCIL OF IRONFOUNDRY ASSOCIATIONS

Chairman : **N. P. Newman**, Newman, Hender and Company, Limited, Woodchester, nr. Gloucester. *Director* : **K. Marshall**. *Secretary* : **J. W. Butler**, Crusader House, 14, Pall Mall, London, S.W.1. 'Phone : Whitehall 7941.

Participating Associations : British Cast Iron Research Association (affiliated) ; Institute of British Foundrymen (affiliated) ; and the following :—

Automobile Ironfounders Association.—Secretaries : Heathcote and Coleman, 25, Bennetts Hill, Birmingham, 2. 'Phone : Midland 2901 ; 'Grams : "Clarify," Birmingham.

British Ironfounders' Association and British Bath Manufacturers' Association.—Director and Secretary : J. Galbraith Sneddon, C.A., 145, St. Vincent Street, Glasgow, C.2. 'Phone : Central 2891 ; 'Grams : "Groundwork," Glasgow.

British Grit Association.—Secretary : J. Campbell MacGregor, 10 Bank Street, Airdrie, Lanarkshire.

British Malleable Tube Fittings Association.—Secretary : F. B. Ridgwell, 196, Shaftesbury Avenue, London, W.C.2. 'Phone : Temple Bar 6052 ; 'Grams : "Brimatufia," London.

Cast Iron Chair Association.—Secretaries : Peat, Marwick, Mitchell & Co., The Cast Iron Chair Association, Queen's Square, Middlesbrough, Yorkshire.

Cast Iron Axlebox Association and National Ingot Mould Association.—Secretaries : Peat, Marwick, Mitchell & Company, 301, Glossop Road, Sheffield. 'Phone and 'Grams : Broomhill 63031.

Cast Iron, Heating, Boiler and Radiator Manufacturers' Association.—Secretary : Stanley Henderson, 69, Cannon Street, London, E.C.4. 'Phone : City 4444.

Cast Iron Pipe Association.—Secretary : T. Clark, Crusader House, 14, Pall Mall, London, S.W.1. 'Phone : Whitehall 7941.

Cast Iron Segment Association.—Secretary : H. A. D. Acland, 5, Victoria Street, London, S.W.1. 'Phone : Abbey 3194.

Greensand Pipe Founders' Association.—Secretaries : McClure Naismith Brodie & Company, 77, St. Vincent Street, Glasgow, C.2. 'Phone : Central 8476 ; 'Grams : "Lycidas," Glasgow.

National Association of Malleable Ironfounders.—Secretary : Miss L. Verity, Chamber of Commerce Offices, Tudor House, Bridge Street, Walsall. 'Phone : Walsall 5671.

IRONFOUNDERS' NATIONAL CONFEDERATION

Chairman : **D. Graham Bisset**, Enfield Foundry Co., Ltd., Waltham Cross. *Director* : **R. Forbes Baird**, 117, Church Lane, Handsworth Wood Birmingham, 20. 'Phone : Northern 0343 & 0037 ; 'Grams : "Irocast," Birmingham.

LOCAL BRANCH ASSOCIATIONS

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NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION

President : **T. Lee**, Henry Hollingdrake & Son Limited, Princes Street, Stockport. *Secretaries* : **Mann, Judd & Co.**, 8, Fredericks Place, Old Jewry, London, E.C.2. 'Phone : Metropolitan 8613 ; 'Grams : "Manjudca Phone," London.

LOCAL ASSOCIATIONS

Cardiff and District Founders' Association.—Secretary : G. Morris, 12, West Bute Street, Docks, Cardiff. 'Phone : Cardiff 4356-7.

Leeds and District Ironfounders' Association.—Secretary : F. Bowling, John Bowling & Co., Ltd., Cyclops Foundry, Kirksall Road, Leeds, 3. 'Phone : Leeds 25183.

Leicester and District Ironfounders' Employers' Association.—Secretary : C. S. Bishop, 8, New Street, Leicester. 'Phone : Leicester 58842.

Liverpool and District Ironfounders' Association.—Secretary : J. S. Hassal, 16/18, Hackins Hey, Liverpool. 'Phone : Central 0114.

Manchester and District Ironfounders' Employers' Association.—Secretaries : Webb, Hanson, Bullivant & Co., 90, Deansgate, Manchester. 'Phone : Blackfriars 8367 ; 'Grams : "Sound," Manchester.

Midland Ironfounders' Association.—Secretary : R. Forbes Baird, 117, Church Lane, Handsworth Wood, Birmingham, 20. 'Phone : Northern 0343. 'Grams : "Jacelace," Birmingham.

Monmouthshire Founders' Association.—Secretary : I. J. Smith, Goulds Foundries, Limited, Newport, Mon. 'Phone : Newport 4275 ; 'Grams : "Rogerwinch," Newport.

North of England Ironfounders' Association.—Secretaries : Mann, Judd, Gordon & Co., 61, Westgate Road, Newcastle-upon-Tyne. 'Phone : Newcastle 20836 ; 'Grams : "Mannca," Newcastle.

North Staffordshire Ironfounders' Association.—Secretary : R. Pepper, 4, St. Anthony's Drive, Westlands, Newcastle, Staffs. 'Phone : Stoke-on-Trent 87303. 'Grams : "Bronze, Phone, Longport."

Scottish Ironfounders' Association.—Secretaries : Mann, Judd, Gordon & Co., 142, St. Vincent Street, Glasgow, C.2. 'Phone : Central 8563 ; 'Grams : "Mannca," Glasgow.

Sheffield and District Ironfounders' Association.—Secretary : T. Goddard Mander, 59, Clarkehouse Road, Sheffield, 10. 'Phone : Sheffield 60047 ; 'Grams : "Emplofedra," Sheffield.

South of England Ironfounders' Association.—Secretaries : Mann, Judd & Co., 8, Fredericks Place, Old Jewry, London, E.C.2. 'Phone : Metropolitan 8613. 'Grams : "Manjudca Phone," London.

Welsh Engineers and Founders' Association.—Secretary : W. D. M. Davis, 1, St. James Gardens, Swansea. 'Phone : Swansea 59166 ; 'Grams : "Iron," Swansea.

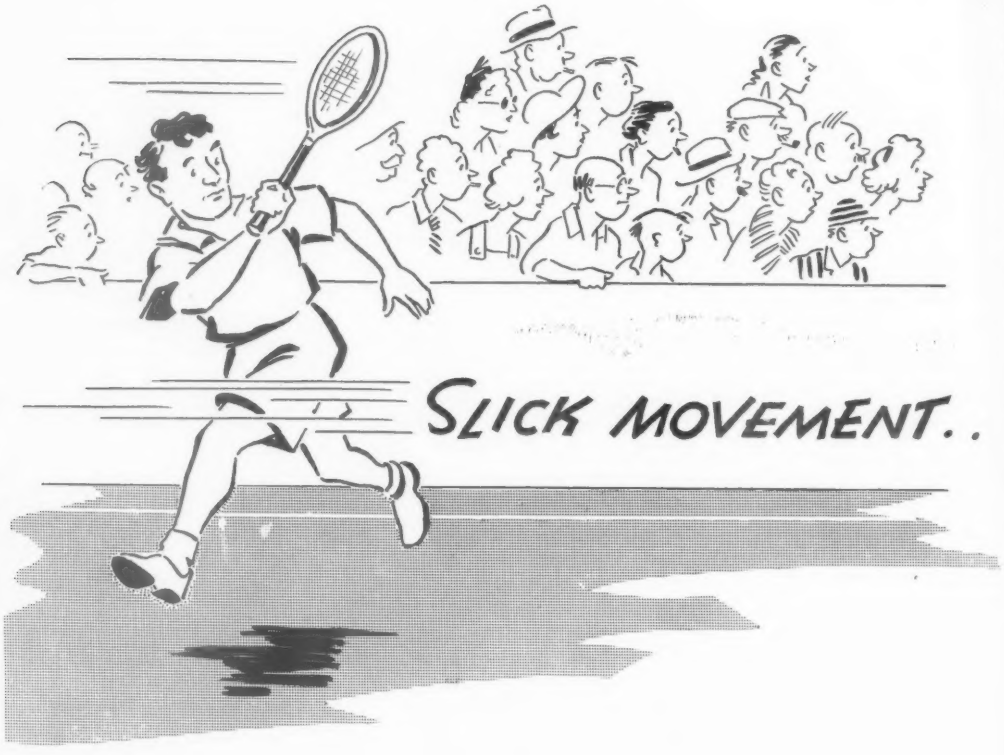
West of England Ironfounders' Association.—Secretary : R. Forbes Baird, 117, Church Lane, Handsworth Wood, Birmingham, 20. 'Phone : Northern 0343. 'Grams : "Jacelace," Birmingham.

West Riding Ironfounders' Association.—Secretary : C. D. Buckle, 13, Cheapside, Bradford. 'Phone : Bradford 25346.

BRITISH CAST IRON RESEARCH ASSOCIATION

Alvechurch, Birmingham. 'Phone and 'Grams : Reddich 716.

Scottish Laboratories.—Blantyre Industrial Estate, Blantyre, Lanarkshire. 'Phone 486.



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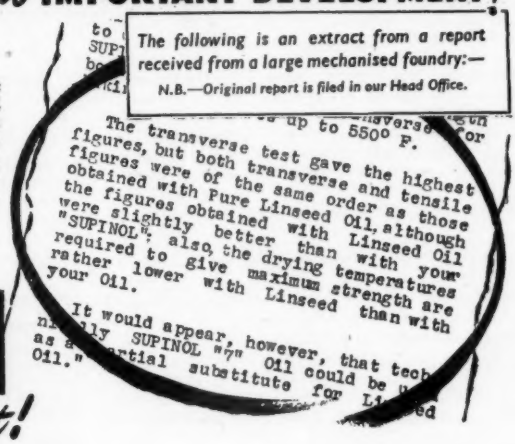
The following is an extract from a report received from a large mechanised foundry:—
N.B.—Original report is filed in our Head Office.

The transverse test gave the highest figures, but both transverse and tensile figures were of the same order as those obtained with Pure Linseed Oil, although the figures obtained with Linseed Oil were slightly better than with your "SUPINOL"; also, the drying temperatures required to give maximum strength are rather lower with Linseed than with your Oil.

It would appear, however, that tech... SUPINOL "7" Oil could be ... as a partial substitute for Li...

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

June 25, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 17s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent P, up to 3 per cent. S), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £14 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 4s. 6d.; South Zone, £17 7s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone £17 14s. 6d.; South Zone, £17 17s.

Cold Blast.—South Staffs, £18 7s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £13 11s. 6d.; Scotland (Scotch iron), £13 18s.; Sheffield, £14 9s. 6d.; Birmingham, £14 17s. 6d.; Wales (Welsh iron), £13 18s.

Basic Pig-iron.—£12 10s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 20s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 31s. 8d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 34s. 8d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr.: max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £43 15s. 2d.

Metallic Manganese.—96/98 per cent., carbon-free, £275 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £40 12s. 6d.; galvanized corrugated sheets, 17/20 g., £57 5s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 6s. 9d.; nickel-chrome-molybdenum, £78 14s.

Tinplates.—57s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £281; high-grade fire-refined, £280 10s.; fire-refined of not less than 99.7 per cent., £280; ditto, 99.2 per cent., £279 10s.; black hot-rolled wire rods, £290 12s. 6d.

Tin.—Cash, £970 to £970 10s.; three months, £967 10s. to £968; settlement, £970 10s.

Zinc.—G.O.B. (foreign) (duty paid). £130; ditto (domestic), £130; "Prime Western," £130; electrolytic, £134; not less than 99.99 per cent., £136.

Lead.—Good soft pig-lead (foreign) (duty paid), £133; ditto (Empire and domestic), £133; "English," £134 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £150 15s.; rolled zinc (boiler plates), all English destinations, £148 15s.; zinc oxide (Red Seal), d/d buyers' premises, £157.

Other Metals.—Aluminium, ingots, £154; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £72 10s. to £73; nickel, £454.

Brass.—Solid-drawn tubes, 27½d. per lb.; rods, drawn, 34½d.; sheets to 10 w.g., 30½d.; wire, 33½d.; rolled metal, 30½d.

Copper Tubes, etc.—Solid-drawn tubes, 32d. per lb.; wire, 313s. 6d. per cwt. basis; 20 s.w.g., 342s. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £225 to £270; BS. 1400—LG3—1 (86/7/5/2), £248 to £280; BS. 1400—G1—1 (88/10/2), £330 to £400; Admiralty GM (88/10/2), virgin quality, £335 to £350 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £335 to £425; L.P.Bl, £285 to £335 per ton.

Phosphor Bronze.—Strip, 43¾d. per lb.; sheets to 10 w.g., 46d.; wire, 49½d.; rods, 44½d.; tubes, 42¾d.; chill cast bars: solids 4s. 5d., cored 4s. 6d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 6¾d. per lb. (7%) to 3s. 7d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 0¾d. (7%) to 4s. 1d. (30%); to 12 in. wide × .056, 3s. 1d. to 4s. 1¾d.; to 25 in. wide × .056, 3s. 3d. to 4s. 3¾d. Spoon and fork metal, unsheared, 2s. 9¾d. to 3s. 10d. Wire, 10g., in coils, 3s. 6¾d. (10%) to 4s. 7d. (30%). Special quality turning rod, 10%, 3s. 5¾d.; 15%, 3s. 10¾d.; 18%, 4s. 3¼d. All prices are net.

Obituary

COLONEL W. C. DEVEREUX

After being taken ill earlier in the day at the Ascot race meeting, COLONEL WALLACE CHARLES DEVEREUX died on Saturday. He was 59. Colonel Devereux, who was managing director of Almin, Limited, was chairman of a number of other companies, including the Fulmer Research Institute, Limited, International Alloys, Limited, Light Alloy Products Company (Birmingham), Limited, Modern Electrolytic Patents & Processes, Limited, Renfrew Foundries, Limited, Southern Forge, Limited, and Structural & Mechanical Development Engineers, Limited.

Educated at King Edward's Grammar School, Aston, he studied metallurgy and engineering. During the 1914-18 war he became superintendent of National Aircraft Factory No. 1. In 1927 he formed High Duty Alloys, Limited, and he also undertook work on the Continent in connection with industrial reconstruction, particularly in Poland and Rumania. On the outbreak of the 1939-45 war he was appointed Director of Light Alloy Forgings and Castings, becoming Controller of North American Aircraft Supply in the Ministry of Aircraft Production in 1941, being responsible for the reception and assembly of American aeroplanes and engines and for their repair.

A member of the British Association for Advancement of Science, the American Society for Testing Metals, and the American Institute of Mining and Metallurgical Engineers, in the latter part of the 1939-45 war he directed surveys into the problems of post-war industry and published reports on the industrial possibilities of South Wales and West Cumberland. In 1945 he delivered the Edward Williams Lecture—"The Future of the Light Metal Foundry Industry"—to the annual conference of the Institute of British Foundrymen in London.

THE DEATH occurred recently of MR. J. L. WING, managing director of Leadbeater & Scott, Limited, crucible steel makers, etc., of Sheffield. He was 54.

MR. H. H. HOLLIS, who recently retired from the chairmanship of the Oxley Engineering Company, Limited, Leeds, has died at the age of 70, after a long illness.

THE DEATH has occurred of MR. LEONARD LANGRICK, who was managing director of the Coghlan Steel & Iron Company, Limited, Leeds, until his retirement in 1945. He was 79.

MR. GEORGE SPENCER, managing director of the Lancashire & Yorkshire Wagon Company, Limited, Heywood, and also director of Foundry Equipment, Limited, and High Grade Castings, Limited, both of Leighton Buzzard, died recently. Mr. Spencer was 60 years of age.

MR. ARCHIBALD ALLAN, of Monkseaton (Northumberland), who died recently aged 59, was an engineer and designer of electrical equipment who had been employed by A. Reyrolle & Company, Limited, Hebburn-on-Tyne (Co. Durham), and the British Thomson-Houston Company, Limited.

Change of Address. The Central Publicity Department of I.C.I. moved to the north block (ground floor) of Thames House, Millbank, S.W.1 (by Lambeth Bridge) on June 23, 1952. (Tel.: VIC 4486.) Written communications should, however, be addressed to Imperial Chemical House, Millbank, S.W.1.

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Midland 3375/6

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13, Rumford St.,
Central 1558

GLASGOW, C.2.
93, Hope Street,
Central 9969

NOTICE

Replies to Box Numbers to be addressed to "Foundry Trade Journal," 49, Wellington Street, London, W.C.2.

SITUATIONS WANTED

FOUNDRY METALLURGIST. 20 years' experience iron, steel, metal, sand, lab. control; fully mechanised and mass production specialist.—Box 1874, FOUNDRY TRADE JOURNAL.

PRACTICAL FOUNDRYMAN, 35, A.M.I.B.F. Chargehand experience, seeks similar position in General or Specialised Non-Ferrous Foundry, Lancashire or Yorkshire, References, Box 1879, FOUNDRY TRADE JOURNAL.

NON-FERROUS FOUNDRY FOREMAN desires change. Used to machine, bench and floor moulding. Green and dry sand. Twenty-five years' experience in high pressure work. Box 1883, FOUNDRY TRADE JOURNAL.

REPRESENTATION. A gentleman with sound commercial and technical experience of all types of castings, forgings, and hot pressings, seeks to handle Home Counties representation of reputable manufacturer. Box 1880, FOUNDRY TRADE JOURNAL.

TECHNICAL BUYER, aged 35, specialist in the requirements of Light Engineering, seeks position of control. Home Counties preferred but will consider other suitable offers. Box 1881, FOUNDRY TRADE JOURNAL.

FOUNDRY TECHNICAL ENGINEER AND CHIEF METALLURGIST, 34, A.I.M. and Premier Award Foundry Management and Science, requires executive post. S. coast pref. but not essential. Experienced General and Fully Mechanised Iron Founding, Light Alloys, Sand and Pressure, Vitreous Enamelling, Welding. Can adapt to other Non-Ferrous work. Company must have progressive, scientific outlook, not rule of thumb. Box 1882, FOUNDRY TRADE JOURNAL.

FOUNDRY WORKS MANAGER, M.I.B.F., aged 37, desires change. 12 years' supervisory experience fully and semi-mechanised iron foundries; high duty and grey iron. Good disciplinarian. Would welcome opportunity of advancement with sound concern, which will appreciate experience and enthusiasm. Would consider investing available capital if necessary.—Box 1872, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive or a woman aged* 18-59 *inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order* 1952

FOREMAN required for West Yorkshire Cupola-Converter Plant to work two shifts. Housing accommodation provided. Only experienced men considered. State salary required. Box 1865, FOUNDRY TRADE JOURNAL.

MALLEABLE IRONFOUNDERS (West Midlands) require experienced Inspector for dimensional checking of Metal Patterns and Coreboxes prior to issue to Foundry. Post calls for a conscientious worker and some experience of A.I.D. methods preferred. Canteen and Social Club facilities available. State salary required. Box 1863, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

FOUNDRY METALLURGIST required by old established Foundry in the South of England. First class man having held similar position and capable of assuming full responsibility for the metallurgical control of a large Jobbing and Mechanized Foundry, Cupolas, Sand, Core Shop, etc., engaged in the production of high class Machine Tool Castings. Write giving details of experience, age, and salary required to East Sussex Engineering Company, Phoenix Ironworks, Lewes, Sussex.

ASSISTANT WORKS CHEMIST FOR EAST OF SCOTLAND.

ANALYTICAL CHEMIST with Higher National Certificate. Experience in ferrous analysis of plain and alloy Cast Irons, mild and alloy Steels (including Stainless). Experience in non-ferrous analysis of Brass, Bronze and Aluminium. Some knowledge of Physical Testing of Metals and Moulding Sands, Metallography and Photography. Salary from £400 upwards according to experience. Box 1870, FOUNDRY TRADE JOURNAL.

APPLICATIONS are invited from highly qualified and experienced persons for the following posts in a mechanised as well as jobbing Steel Foundry in Calcutta, India. The foundry produces a wide variety of Steel Castings up to 7 tons finished weight for Railway Locomotives, Wagon and Coaching underframe, Cement, Sugar and other industries. It is very well equipped with modern equipment such as Sand Slinger, Moulding Machines, Core Blower, Sand Conditioning System, Laboratory, etc. Both green and dry sand methods are used.

1. FOUNDRY ENGINEER: He should have a very sound knowledge of Methoding, Planning and Progressing in Drawing Office, Pattern Shop, Moulding Shop, Core Making Shop, Heat Treatment and Fettling Shop; in fact all the operations connected with the production of castings except steel making and machining. Experience in a similar capacity in any large Steel Foundry in United Kingdom or European Continent essential. Should be a good Organiser and Administrator. Pay up to Rs. 2,500 per month, depending upon qualifications, subject to income tax. Free furnished quarters and transport to and from works. Three years' contract, with free passage for self and wife to and from India.

2. FOUNDRY PRODUCTION MANAGER: He should have a very sound knowledge of Moulding, Core Making, Sand Control and Pattern Making by latest methods. Should be able to take charge of actual production in Moulding, Pattern and Core Making Shops. Previous experience and good organising and administrative ability and ability to train men is essential. Knowledge of quality and cost control is also required. Pay up to Rs. 2,000 per month, depending upon qualifications, and subject to income tax. Other terms as for first post.

Applications should be addressed to M/s. BHARTIA ELECTRIC STEEL CO., LTD., 42, Shibtolla Street, Calcutta, 7, India, and copies of the same must be forwarded to Company's Works Manager, Mr. N. G. Chakravarti, c/o Mrs. Phyllis Dalrouski, 154, Oakbrook Road, Sheffield, 11, England, who will interview suitable candidates after 15th July, 1952, in Sheffield.

SITUATIONS VACANT—*Contd.*

GOOD PATTERNMAKER required. London district.—Box 1884, FOUNDRY TRADE JOURNAL.

TRAVELLER WANTED for the sale of protective clothing. Must have sound connection. London man preferred. Write to J. MOON & SON, 94, Sclater Street, London, E.1.

MOULDERS. Jobbing Moulders required for iron Foundry; rate 3/6d. per hour, plus £2 week bonus, plus merit bonus. Also all classes of Foundry labour. P.M.A., 136, Bramley Road, W.10. LAD. 3692.

WANTED. Foundry Manager to take complete control of Foundry producing refined Pig Iron. This position is of extreme importance and only persons with the necessary drive and experience need apply. Excellent prospects and an assured future for the right man. Box B.7887, W. H. Smith & Son, Ltd., Manchester, 3.

PATTERN MAKER. First-class man required by large Foundry—in Republic of Ireland—producing high quality domestic appliances. Must be experienced in Plaster, Lead and Tin and Wood pattern equipment for both machine and floor moulding. The position offers scope and variety together with good salary for keen man. House available for successful applicant. Write in first instance giving particulars of experience, etc., to Box 1875, FOUNDRY TRADE JOURNAL.

GENERAL MANAGER required for an Iron and Non-Ferrous Foundry in the West of Scotland. The Foundry has a combined output of 100 tons of castings per week and produces pressure and engineering castings up to a weight of one ton. Applicants must have considerable experience in this class of work and a good knowledge of modern foundry methods. Good prospects. State salary required and previous experience. Box 1876, FOUNDRY TRADE JOURNAL.

K. & L. STEELFOUNDERS and ENGINEERS LIMITED, have a vacancy in their Steel Foundry Division for a Mechanical and Metallurgical Graduate between 30 and 35 years of age. The position will carry a good salary and offers opportunity for rapid advancement. Housing accommodation will be provided if necessary. Applications are invited from men who are prepared to make their career on the production side of a large modern steel foundry. Previous experience not essential as adequate training will be given where required. Full details in confidence to Development Director, K. & L. STEELFOUNDERS AND ENGINEERS LIMITED, Letchworth.

A FOUNDRY MANAGER required by Baker Perkins Limited for their grey iron general jobbing foundry at Westwood Works, Peterborough, which produces castings for own consumption up to 5 tons each, also small quantity of steel castings. Applications are invited from candidates fully experienced in use of all types of foundry mechanical aids, *e.g.* sandrammers, etc., and of the practical crafts involved, combined with good knowledge of metallurgy, sand control (natural and synthetic) and the ability to lead a labour force of 236. Conditions of employment are in accordance with first class modern practice and include contributory pension and life assurance schemes and profit sharing scheme after two years' service. Applications, which should include full details of age, education, training, experience, present position and salaries earned should be addressed to the Personnel Manager and will be treated in the strictest confidence. The Company will regard as candidates only those who have held a similar position elsewhere.

SITUATIONS VACANT—*Contd.*

TECHNICAL REPRESENTATIVE required by manufacturing engineers north of London. Wide technical and practical experience required for visiting foundries to ensure quality control. Write experience, age and salary required to Box 1878, FOUNDRY TRADE JOURNAL.

A WELL-KNOWN Midland Aluminium and Bronze Foundry has a vacancy for a CHIEF METALLURGIST, preferably with foundry experience. This is an excellent opportunity for a capable man to obtain a progressive position with a modern firm. State experience, age, and salary required.—Box 1885, FOUNDRY TRADE JOURNAL.

QUALIFIED METALLURGICAL CHEMIST required, to take charge of Foundry Laboratory. Practical experience in Grey Iron Foundries essential. Knowledge of chilled iron processes desirable.—Write, stating age, experience, and salary required, to PERSONNEL OFFICER, E. R. & F. Turner, Ltd., Ipswich.

FOUNDRY FOR SALE

FOR SALE.—Small well equipped Non-ferrous Foundry, South London. —Box 1873, FOUNDRY TRADE JOURNAL.

FOUNDRY WANTED

REQUIRED by Industrial Group, large Ferrous Foundry. Also, Non-ferrous Foundry with die-casting.—Box 1818, FOUNDRY TRADE JOURNAL.

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Sefton Street, Blackpool, Lancs.
12th June, 1952.

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Telephone: Slough 22877.

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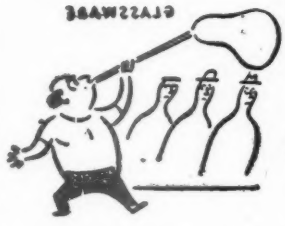

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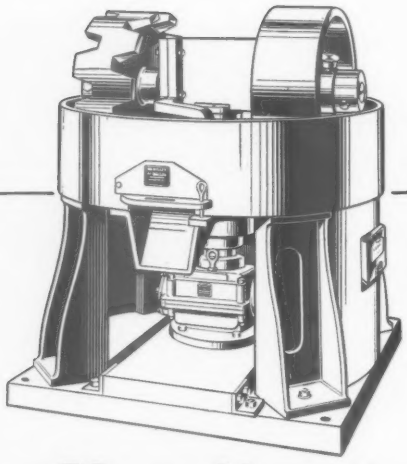

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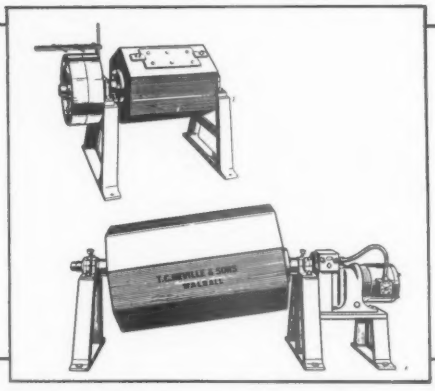

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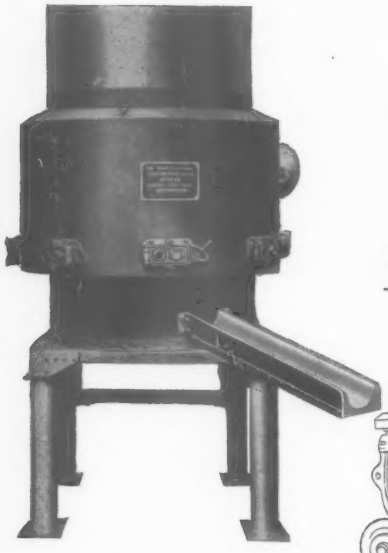

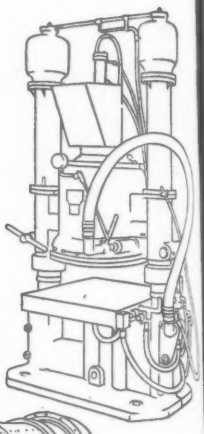

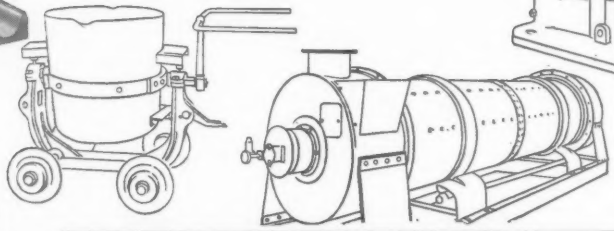

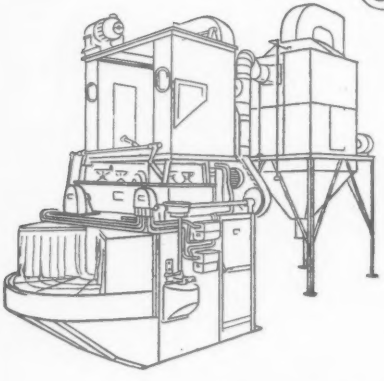

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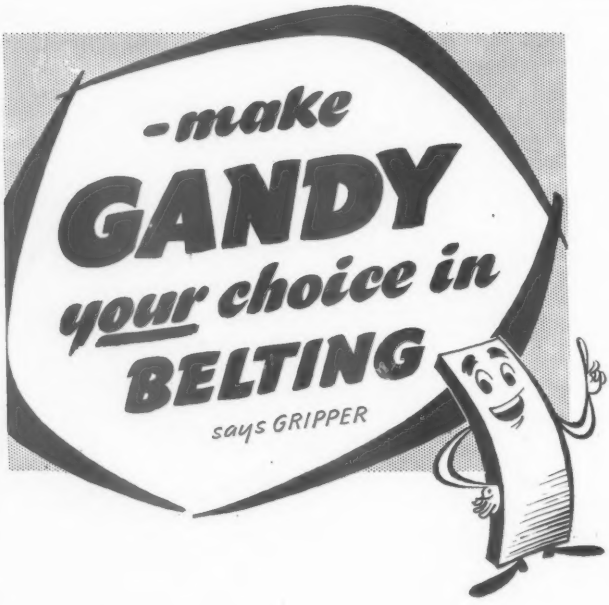

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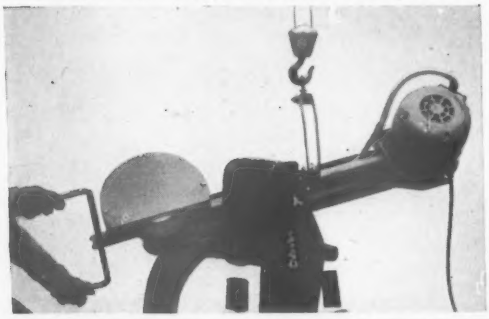

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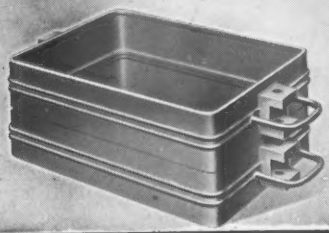

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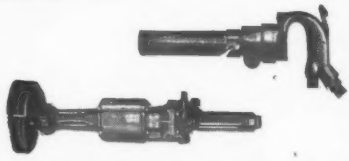

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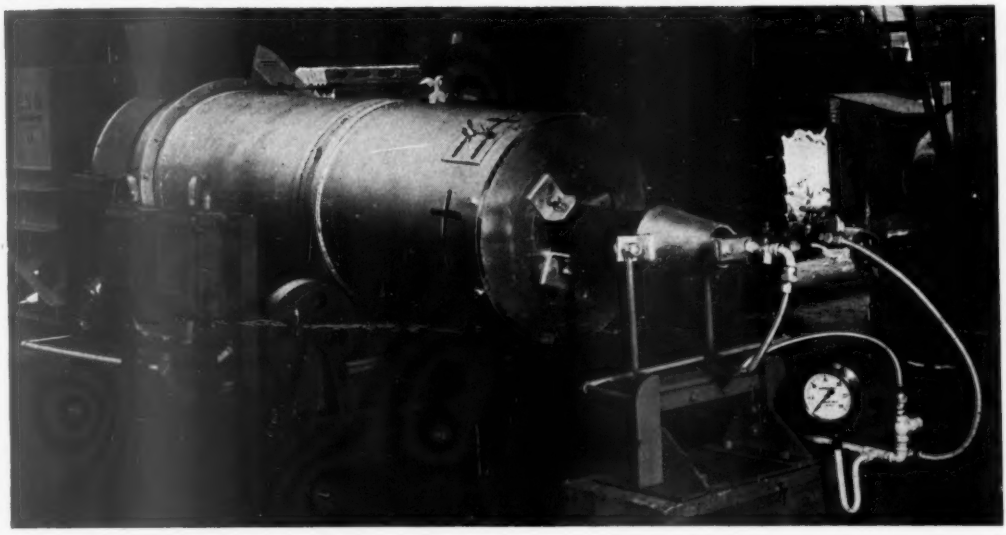

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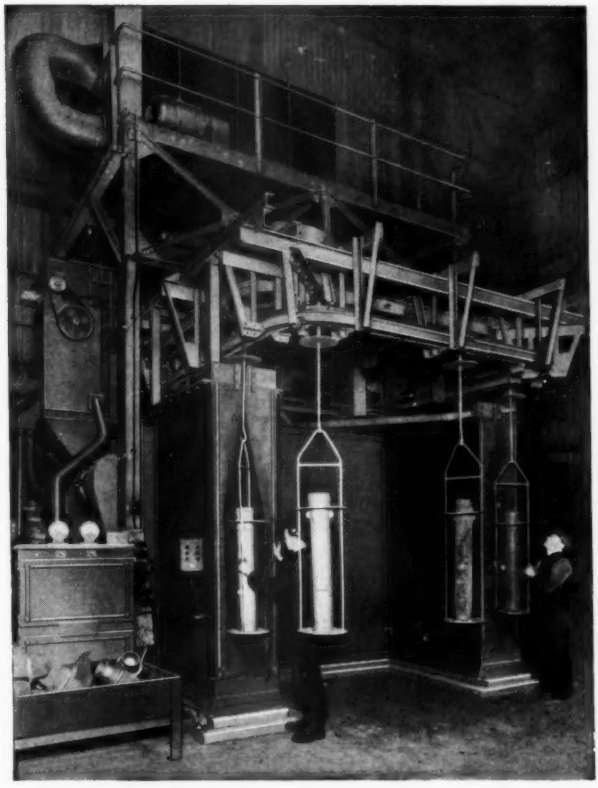

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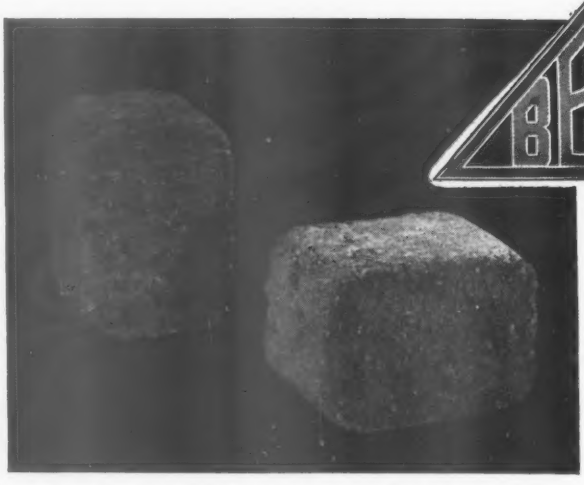

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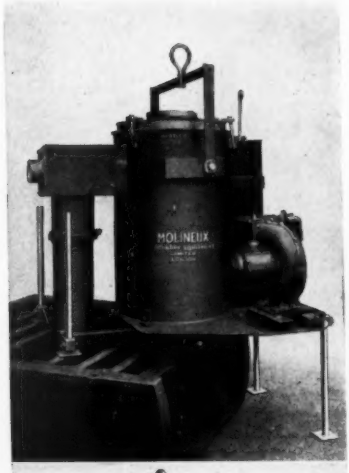

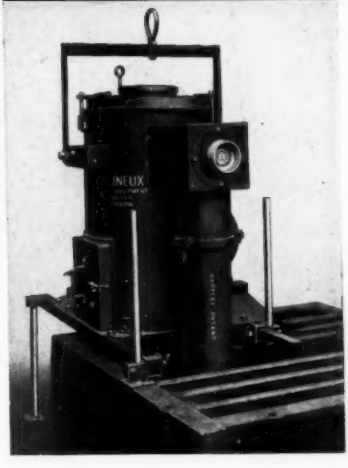

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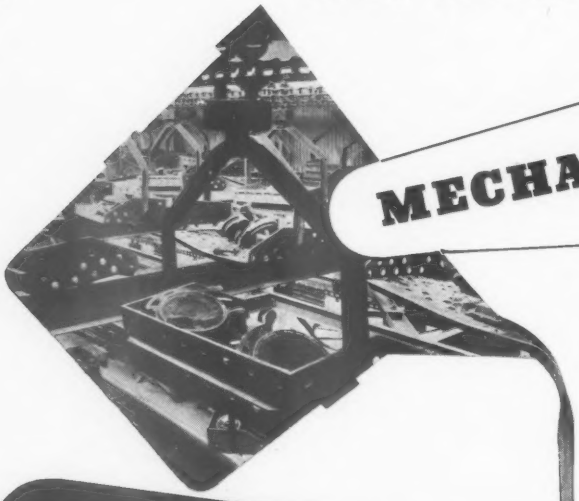

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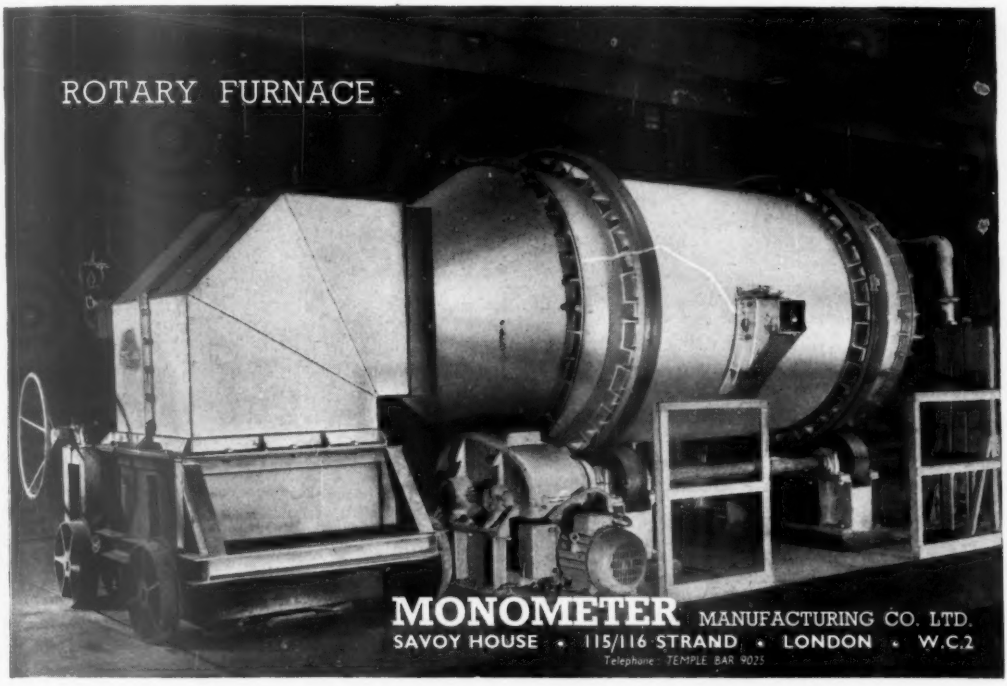

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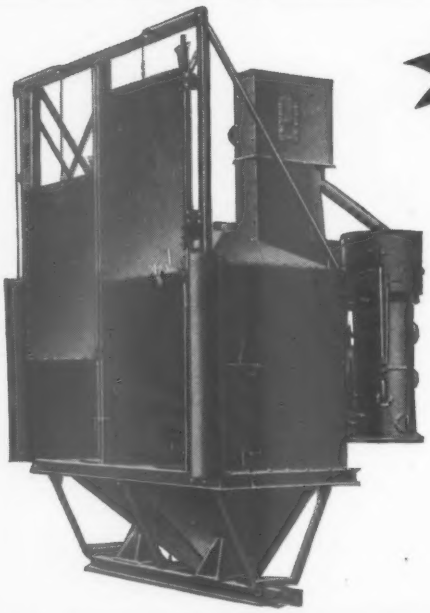

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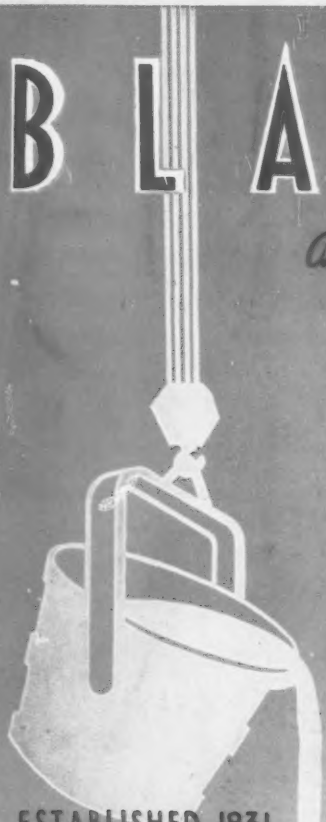

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